1997

Revised

EV1™

Battery and Charging System

Service Manual

CS CamScanner

CAUTION

To reduce the chance of personal injury and/or property damage, the following instructions must be carefully observed.

Proper service and repair are important to the safety of the service technician and the safe, reliable operation of all motor vehicles. If part replacement is necessary, the part must be replaced with one of the same part number or with an equivalent part. Do not use a replacement part of lesser quality.

The service procedures recommended and described in this service manual are effective methods of performing service and repair. Some of these procedures require the use of tools specifically designed for the purpose.

Accordingly, anyone who intends to use a replacement part, service procedure, or tool that is not recommended by the vehicle manufacturer must first determine that neither his safety nor the safe operation of the vehicle will be jeopardized by the replacement part, service procedure, or tool selected.

It is important to note that this manual contains various "Cautions" and "Notices" that must be carefully observed in order to reduce the risk of personal injury during service or repair or the possibility that improper service or repair may damage the vehicle or render it unsafe. It is also important to understand that these "Cautions" and "Notices" are not exhaustive; it is impossible to warn of all the possible hazardous consequences that might result from failure to follow these instructions.

This vehicle has a high voltage power system. Disabling the system is required when working on or around the high voltage system and high voltage battery pack (other than testing the system using the procedures in this manual).

To help avoid severe shocks and burns and vehicle damage, always follow the cautions in this manual to disable the high voltage system. See the high voltage disable and enable procedure in the front of this service manual.

This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to "CAUTIONS" under "On-Vehicle Service" and the SIR Component and Wiring Location views in the "SIR Service Manual" before performing service on or around SIR components or wiring. Failure to follow "CAUTIONS" could result in possible air bag deployment, personal injury, otherwise unneeded SIR system repairs.

To help avoid accidental air bag deployment and personal injury, when servicing a vehicle that requires repair of the SIR system and another vehicle system, it is recommended that the SIR be repaired first using service manual procedures.

CAUTION

Saturn Service Manuals are intended for use by professional, qualified technicians. Attempting repairs or service without the appropriate training, tools, and equipment could cause injury to you or others and damage to your vehicle that may cause it not to operate.

All information, illustrations and specifications contained in this guide are based on the latest product information that was available at the time of publication. Saturn reserves the right to make changes at anytime without notice.

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BATTERY AND CHARGING SYSTEM

NOTICE

Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application.

Saturn Corporation will call out those fasteners that require a replacement after removal. Saturn Corporation will also call out the fasteners that require thread lockers or thread sealant.

UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener.

When you install fasteners, use the correct tightening sequence and specifications.

Following these instructions can help you avoid damage to parts and systems.

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GLOSSARY OF ACRONYMS

Acronym	Definition
ABS	Anti-Lock Braking System
AM	Amplitude Modulation
Amp	Ampere
APM	Accessory AC and DC Power Control Module. With PIM, makes up PEB
APS	Auxiliary Power Supply (part of APM)
BCA	Bias Control. Assembly
BPM	Battery Pack Module
BRS	Battery Reserve Switch
BTCM	Brake/Torque Control Module
BTSI	Brake Transmission Shift Interlock (GM)
CD	Compact Disc
cfm	Cubic Feet per Minute
cg	Center of Gravity
CHMSL	Center High-Mount Stop Lamp
CMC	Compressor Motor Controller (part of APM)
CPA	Connector – Positive Assurance
CR	Charge Receptacle
CRFM	Condenser Radiator Fan Module (part of HPVS)
CTPS	Check Tire Pressure System
DC	Direct Current
DLC	Data Link Connector
DERM	Diagnostic and Energy Reserve Module (SIR control module)
DIA	Dealer Installed Accessory
DM	Drive Motor
DRL	Daytime Running Light
E/M	English/Metric
ECM	Engine Control Module (used with internal combustion engines)
EHPS	Electro-Hydraulic Power Steering
EKP	External Keypad
EMB	Electro-Magnetic Brake (part of ABS)
EMI	Electromagnetic Interference
EPS	Electric Power Steering. Also see EHPS

GLOSSARY OF ACRONYMS CONTINUED

Acronym	Definition
ETS	Electronic Traction System
EV	Electric Vehicle
EVO	Electronic Variable Orifice Control (in power steering pump)
FLIP	Forward Lamp – Instrument Panel Harness. Name of major EV low voltage wire harness
FM	Frequency Modulation
FOD	Front of Dash
g	Gram
GFI	Ground Fault Interrupt
GVMR	Gross Vehicle Mass Rating
GVW	Gross Vehicle Weight
HPVM	Heat Pump Ventilation Module
HPVS	Heat Pump Ventilation System. Similar to HVAC on ICE vehicles
HTCM	HPVS/Thermal Control Module
HV	High Voltage
HVAC	Heating, Ventilating, and Air Conditioning (on ICE vehicles. For EV, see HPVS).
HWS	Heated Windshield
HWS	Hand Wheel Sensor
Hz	Hertz (cycles per second)
I/O	Input(s)/Output(s)
IC	Integrated Circuits
IGBT	Isolate Gate Bipolar Transistor
IP	Instrument Panel
ISRV	Inside Rear View (mirror)
JB	Junction Block
KAM	Keep Alive Memory
kg	Kilogram
km	Kilometer
km/h	Kilometers per hour

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GLOSSARY OF ACRONYMS CONTINUED

Acronym	Definition
kPa	Kilo Pascals
kW	Kilowatt
kWh	Kilowatt–hour
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LF	Left Front
LH	Left Hand
LHD	Left Hand Drive
LHJB	Left Hand Junction Block
LR	Left Rear
LVW	Loaded Vehicle Weight
m	Meter
MMC	Metal Matrix Composite (Rear Brake Drum Material)
MHz	Megahertz
mi	Mile(s)
MPH	Miles Per Hour
MSRP	Manufacturers Suggested Retail Price (includes dealer preparation)
MUX	Multiplex or Multiplexer
N	Newton(s)
NTF	No Trouble Found. Reported failure does not reoccur under test
OEM	Original Equipment Manufacturer
OSRV	Outside Rear View (mirror)
PCM	Propulsion Control Module (Drive Motor)
PDT	Portable Diagnostic Tool
PEB	Power Electronics Bay
PIM	Power Inverter Module
POA	Part of Assembly
PRND	Park–Reverse–Neutral–Drive, as in PRND Selector
PROM	Programmable Read Only Memory
PSOC	Pack State of Charge
PTC	Positive Thermal Coefficient. Term for resistive heating module
PWM	Pulse Width Modulation, or Pulse Width Modulated

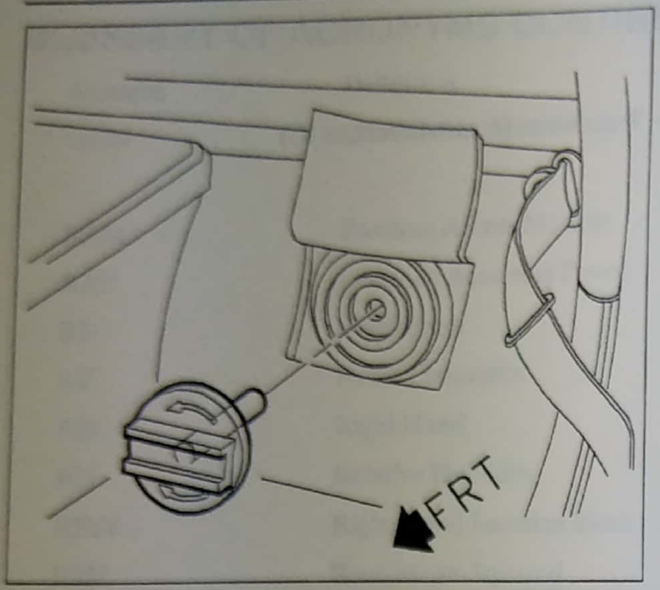
GLOSSARY OF ACRONYMS CONTINUED

Acronym	Definition
QDM	Quad Driver Module
RAM	Random Access Memory
RAP	Retained Accessory Power
RF	Right Front
RF	Radio Frequency
RH	Right Hand
RH	Relative Humidity
RHJB	Right Hand Junction Block
RMS	Root-Mean-Squared
ROM	Read Only Memory
RP	Reduced Performance
RPM	Revolutions Per Minute
RR	Right Rear
RSA	Run/Lock Shifter Assembly
SAE	Society of Automotive Engineers
SDL	Serial Data Link
SDM	Sensor Diagnostic Module
SIR	Supplemental Inflatable Restraint (air bag) system
SLA	Short-Long Control Arm (suspension system)
SOC	State of Charge (battery pack). Usually expressed as a percentage
SN	Service Now
SSPO	Saturn Service Parts Operation
SS	Service Soon
SWA	Steering Wheel Angle
TNF	Trouble – Not Found. Reported failure reoccurs but cause cannot be determined
TJB	Trunk Junction Block
TOD	Time of Day
TPA	Terminal – Positive Assurance
T/S	Turn Signal
TT	Telltale

GLOSSARY OF ACRONYMS CONTINUED

Acronym	Definition
UART	Universal Asynchronous Receiver – Transmitter (communications IC)
UH	Under Hood
ULEV	Ultra-Low Emissions Vehicle
USOC	User State of Charge
V5B	5 Volt Supply
VAC	Voltage, Alternating Current
VF	Vacuum Fluorescence
VH	Vehicle Handling
VIN	Vehicle Identification Number
VTD	Vehicle Theft Deterrent
W	Watt
WSS	Wheel Speed Sensor (part of ABS)
WSW	Windshield Washer/Wiper
ZEV	Zero Emission Vehicle

HIGH VOLTAGE DISABLE



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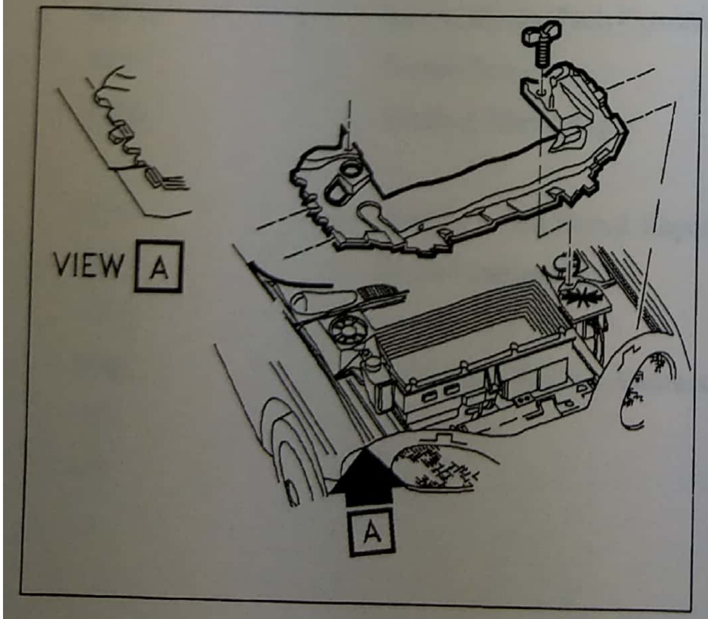
REMOVAL

CAUTION: **TO REDUCE THE RISK OF SEVERE SHOCKS AND BURNS, THE HIGH VOLTAGE SYSTEM SHOULD BE DISABLED ANY TIME SERVICE WORK IS BEING PERFORMED ON OR AROUND THE HIGH VOLTAGE SYSTEM. WHEN IN DOUBT, ALWAYS DISABLE THE HIGH VOLTAGE SYSTEM. THE 12 VOLT SYSTEM WILL STILL BE ACTIVE AFTER THE HIGH VOLTAGE SYSTEM HAS BEEN DISABLED.**

1. Place the vehicle in the “RUN” mode.
2. Remove the manual disconnect knob.
    a. Tilt the driver’s seat forward.
    b. Raise the carpet flap, located on the battery tunnel behind the driver’s seat.
    c. Turn the manual disconnect knob counterclockwise and pull the manual disconnect knob straight out.

IMPORTANT: An audible click should be heard when turning the manual disconnect knob. This click indicates the automatic disconnect relays have opened.

3. Verify high voltage has been removed.
    a. Connect Scan tool to the data link connector (DLC) and run the High Voltage special test. Battery pack module (BPM) diagnostic trouble codes (DTCs) 312, 280 and/or 275 should be present, which indicates BPM and auto disconnect recognized a high voltage disconnect.
    b. If test fails, refer to service manual “High Voltage Special Test Failed” in the “Battery and Charging System” service manual.
4. Remove engine compartment sight shield.



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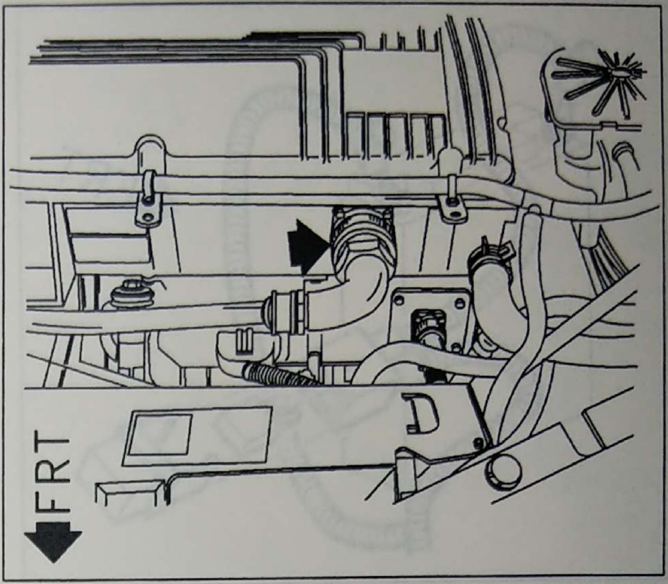
CAUTION: TO REDUCE THE RISK OF SEVERE SHOCKS AND BURNS, ALWAYS ASSUME THE HIGH VOLTAGE IS PRESENT WHEN DISCONNECTING THE CHARGE RECEPTACLE TO PIM CONNECTOR. DO NOT ALLOW THE CONNECTOR BODY TO TOUCH THE PINS OF THE PIM WHEN REMOVING THE CONNECTOR.

5. Remove the charge receptacle to power inverter module (PIM) cannon connector using one hand.



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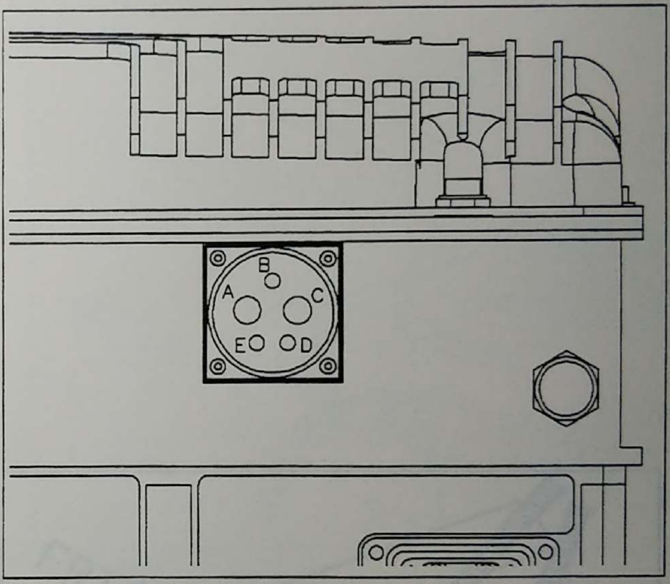
6. Using a DVOM and only one hand, measure from pin A of the PIM to chassis ground and from pin C of the PIM to chassis ground and from pin A to C. All measurements should be less than 10 volts. Pin C and Pin A are the large high voltage pins on the PIM.
   a. If the voltage is less than 10 volts, high voltage system is disabled.
   b. If the voltage is greater than 10 volts, refer to the "High Voltage" section in the "Battery and Charging" service manual.



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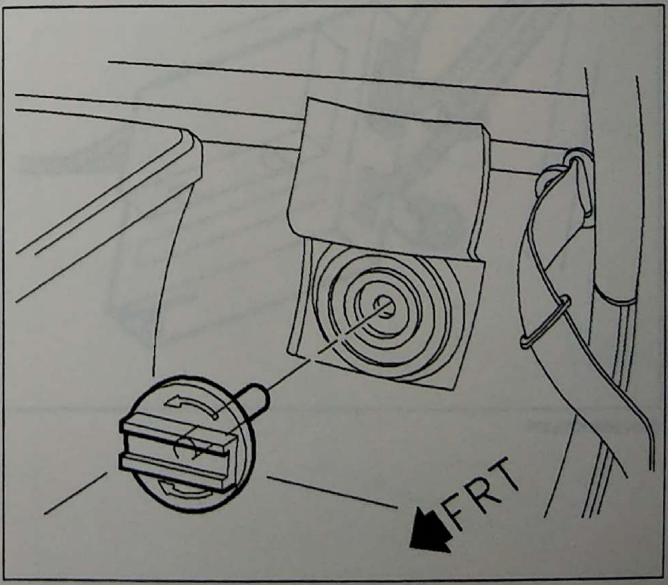
HIGH VOLTAGE ENABLE

INSTALLATION

1. Install charge receptacle to PIM cannon connector.
2. Install engine compartment sight shield.
3. Tilt driver's seat forward.
4. Raise the carpet flap, located on the battery tunnel behind the driver's seat.
5. Install the manual disconnect knob by pushing the shaft straight into the hole and turning clockwise.
6. Clear all DTCs using the Scan tool.



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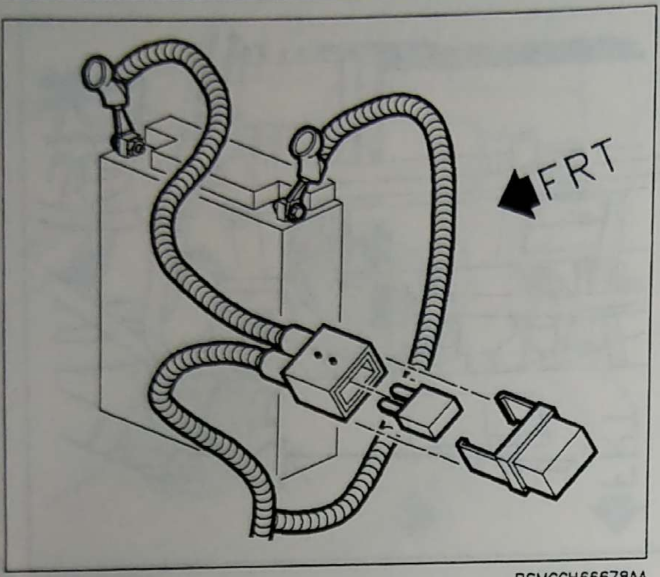

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12 VOLT SYSTEM DISABLE

CAUTION: **DISABLE THE 12 VOLT ELECTRICAL SYSTEM TO HELP AVOID PERSONAL INJURY OR POSSIBLE DAMAGE.**

IMPORTANT: The key pad must be in the LOCK mode for two minutes prior to performing the following step. Failure to do so could result in the loss of memory that retains the battery pack state of charge. If this occurs refer to "Battery Pack and Charging System" service manual for details.

1. Remove the cover on the 60 amp maxi fuse holder located in the negative auxiliary battery cable.
2. Remove the 60 amp maxi fuse.

12 VOLT SYSTEM ENABLE

1. Install 60 amp maxi fuse located on the negative auxiliary battery cable.
2. Place cover on maxi fuse holder.

SIR SYSTEM

ON VEHICLE SERVICE

SERVICE PRECAUTIONS

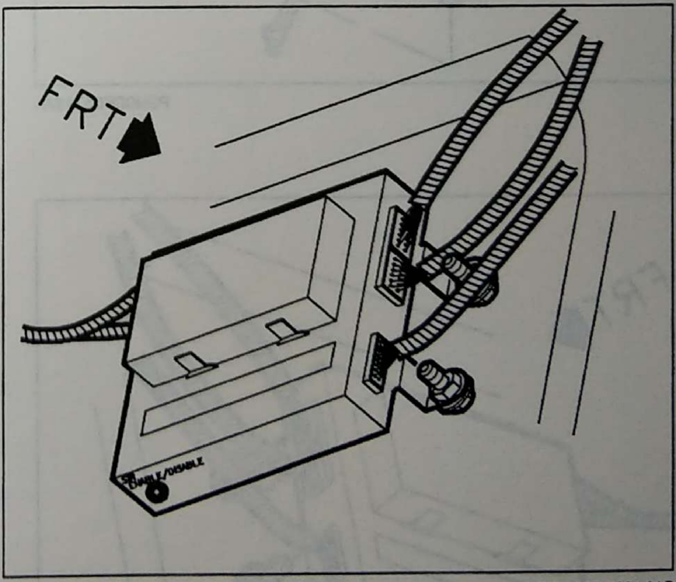
CAUTION: WHEN PERFORMING SERVICE ON OR AROUND SIR COMPONENTS OR SIR WIRING FOLLOW THE PROCEDURE BELOW TO TEMPORARILY DISABLE THE SIR SYSTEM. FAILURE TO FOLLOW PROCEDURES COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY OR OTHERWISE UNNEEDED SIR SYSTEM REPAIRS.

THE SENSING AND DIAGNOSTIC MODULE (SDM) CAN MAINTAIN SUFFICIENT VOLTAGE TO CAUSE A DEPLOYMENT FOR UP TO *10 MINUTES* AFTER THE KEY PAD HAS BEEN PLACED IN THE "LOCK" MODE, ALSO IF THE AUXILIARY BATTERY IS DISCONNECTED OR THE SIR "ENABLE/DISABLE" SWITCH IS PLACED IN THE DISABLE POSITION. MANY OF THE SERVICE PROCEDURES REQUIRE THE SIR "ENABLE/DISABLE" SWITCH TO BE PLACED IN THE "DISABLE" POSITION AND DISCONNECTION OF THE DEPLOYMENT LOOPS TO AVOID AN ACCIDENTAL DEPLOYMENT.

DISABLING THE SIR SYSTEM

1. Turn the steering wheel so that the vehicle's wheels are pointing straight ahead.
2. Place the key pad in the **LOCK** mode.
3. Place the SIR **"ENABLE/DISABLE"** switch in the right hand junction block in the **DISABLE** position.

IMPORTANT: With the SIR **ENABLE/DISABLE** switch in the **DISABLE** position and the key pad in the RUN mode, the AIR BAG telltale lamp will be "On." This is normal operation and does not indicate an SIR system malfunction.



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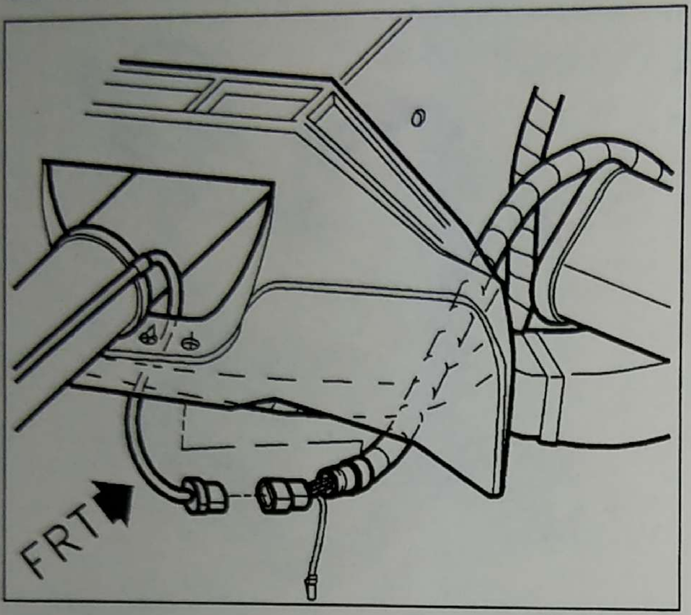

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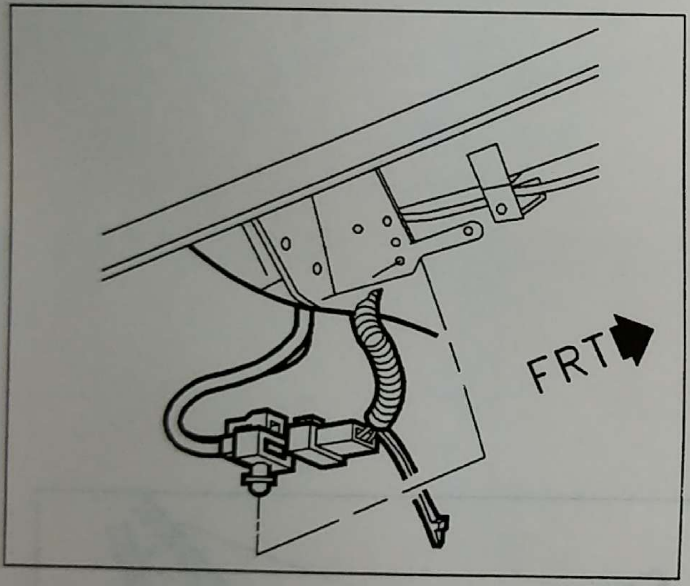
4. Remove connector position assurance (CPA) device and disconnect yellow two-way connector located near the base of the steering column.



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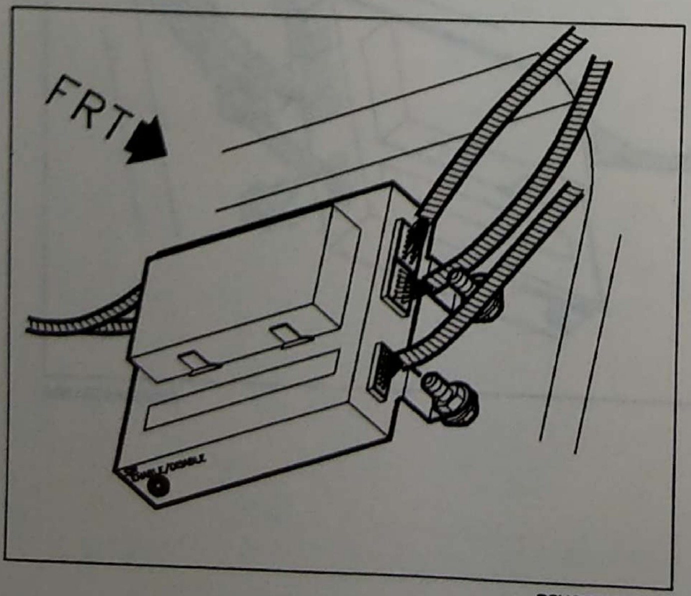
5. Remove connector position assurance (CPA) device and disconnect yellow two-way connector located on passenger inflator module pigtail under RH side of I/P.



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ENABLING THE SIR SYSTEM

1. Place key pad in the **LOCK** mode.
2. Connect yellow two-way SIR connector at the base of steering column and install connector position assurance (CPA) device to connector.
3. Connect yellow two-way passenger inflator module pigtail and install connector position assurance (CPA) to connector.
4. Place SIR **ENABLE/DISABLE** switch to the **ENABLE** position, located in the RH junction block.
5. Place key pad in the "RUN" mode and verify that the AIR BAG telltale lamp flashes seven times as the key pad is placed in the "RUN" mode and then goes Off. If lamp does not operate as described above perform the "SIR Diagnostic System Check" in this manual.

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SPECIAL TOOLS

TOOL NUMBER	TOOL DESCRIPTION
EV9713Z	Junction Box Ground Strap
EV9718Z	Fluke 87 Multimeter
EV9735Z	Digital Instulation Tester
EV9714Z	Battery Pack To PIM Extension Cable With DVM
EV9727E	Battery Module Lift Tool
EV9730E	Battery Pack Tray Support Tee
EV9737E	Vent System Tester
EV9725Z	BPM Pinout Box
EV9734Z	Battery Pack Breakout Box
EV9728E	Battery Pack Lift Table

LIFTING, JACKING, AND SUPPORT POINTS

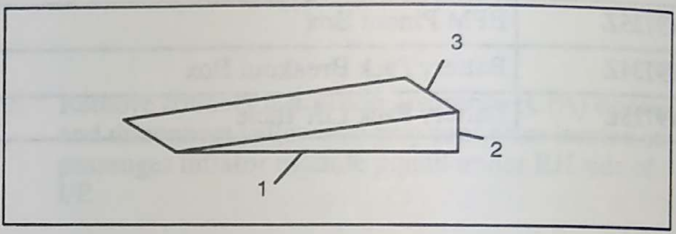
CAUTION: TO HELP AVOID PERSONAL INJURY WHEN A VEHICLE IS ON A HOIST, PROVIDE ADDITIONAL SUPPORT FOR THE VEHICLE. THIS WILL REDUCE THE POSSIBILITY OF THE VEHICLE FALLING OFF THE HOIST.

CAUTION: TO HELP AVOID PERSONAL INJURY, ALWAYS USE JACK STANDS WHEN WORKING ON OR UNDER ANY VEHICLE THAT IS SUPPORTED ONLY BY A FLOOR JACK OR A HOIST.

NOTICE: When lifting with a frame contact hoist, and battery pack removal is not necessary, lift the vehicle on the body side frame-lower pinch weld flanges at specific lift locations. (Location views on next page.)

NOTICE: Because of the uniqueness of the design of the EV1 and its ground clearance, it is necessary to follow the hoisting directions very carefully. With an inground two post front and rear hoist, it may be necessary to use either low profile arms or ramps as needed in the front lift pad area to keep the fascia from being damaged when approaching or leaving the hoisting area. Ramp size needed:

1. **1050 mm in length (41-3/8 in.)**
2. **155 mm in height (6-7/64 in.)**
3. **230 mm in width (9-1/16 in.)**

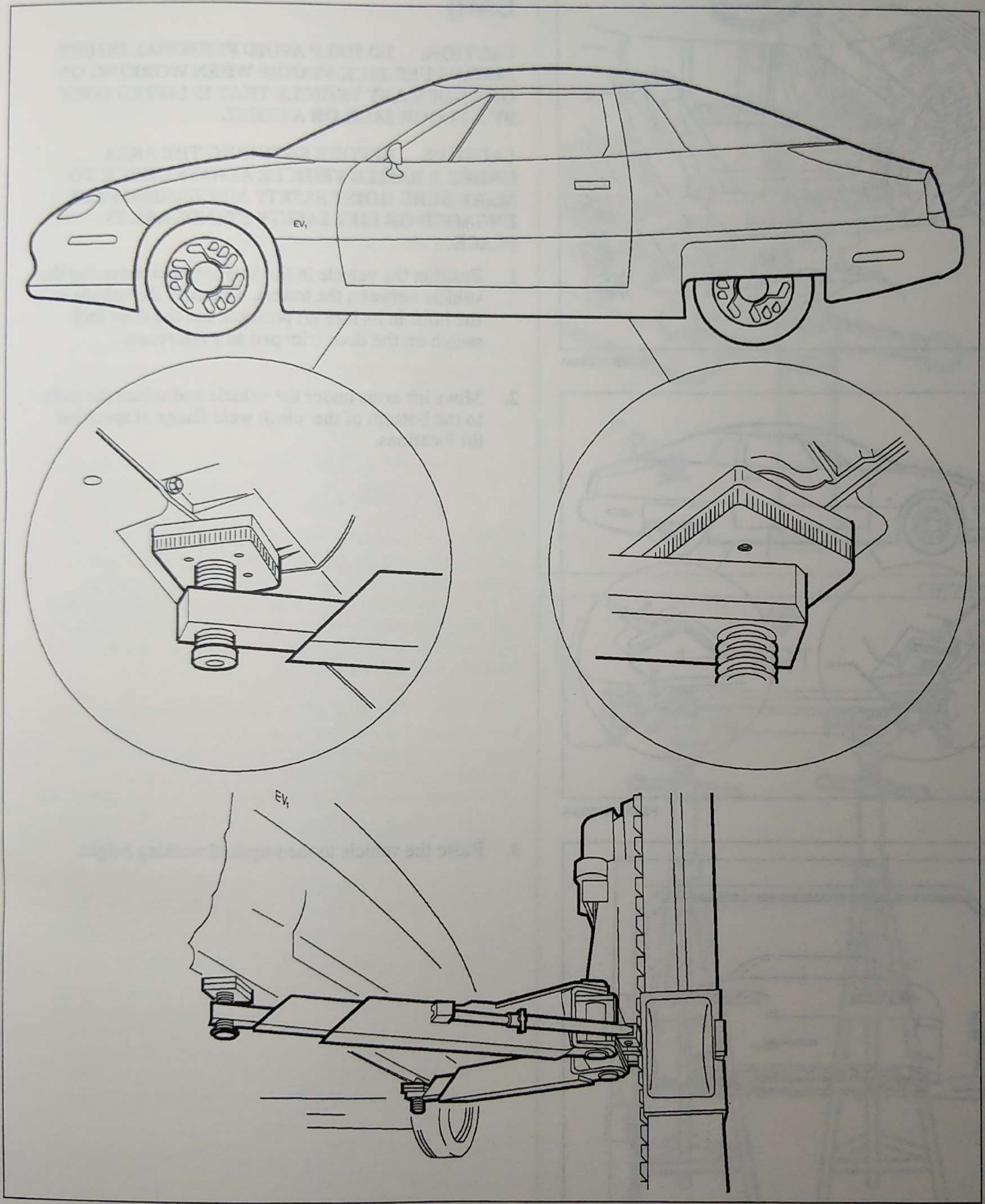


NOTICE: When lifting with a suspension contact hoist, position the front hoist lift pads under the lower control arms. Lift from under the rear tires for rear suspension. (Refer to "Hoisting/Lifting for a Two Post In Ground Hoist Front and Rear" in this section for more information and illustrations.)

When battery pack removal is required, the use of two rear lift pad adaptors must be used. These lift pad adaptors are obtainable from:

General Motors Dealer Equipment
Telephone: 1-800–GM–TOOLS

GENERAL INFORMATION



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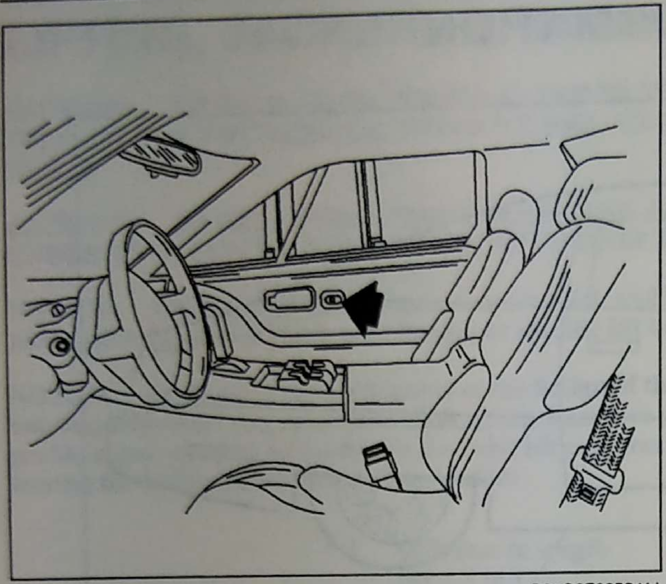
HOISTING/LIFTING FOR A 2 POST ABOVE GROUND HOIST – (SIDE CAR)

CAUTION: TO HELP AVOID PERSONAL INJURY, ALWAYS USE JACK STANDS WHEN WORKING ON OR UNDER ANY VEHICLE THAT IS LIFTED ONLY BY A FLOOR JACK OR A HOIST.

CAUTION: BEFORE ENTERING THE AREA UNDER A RAISED VEHICLE ALWAYS CHECK TO MAKE SURE HOIST SAFETY MECHANISMS ARE ENGAGED OR LIFT SAFETY STANDS ARE IN PLACE.



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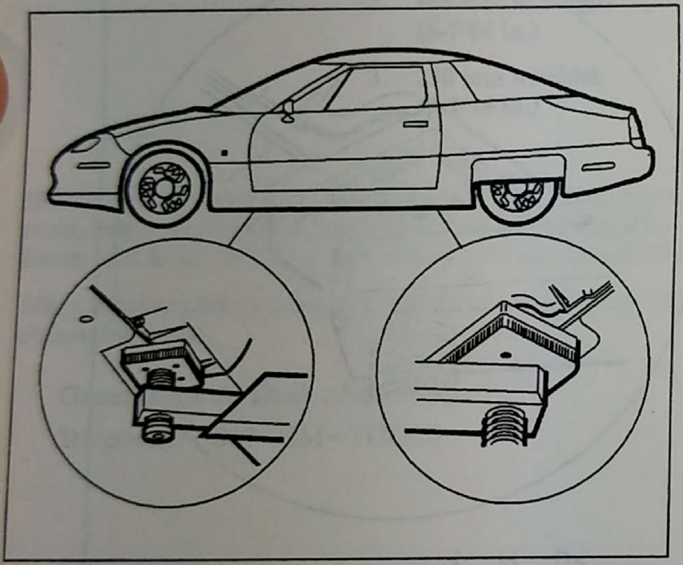
1. Position the vehicle in the hoisting area centering the vehicle between the towers. To center the vehicle to the hoist in its fore aft position, use the door lock switch on the door trim pad as a reference.



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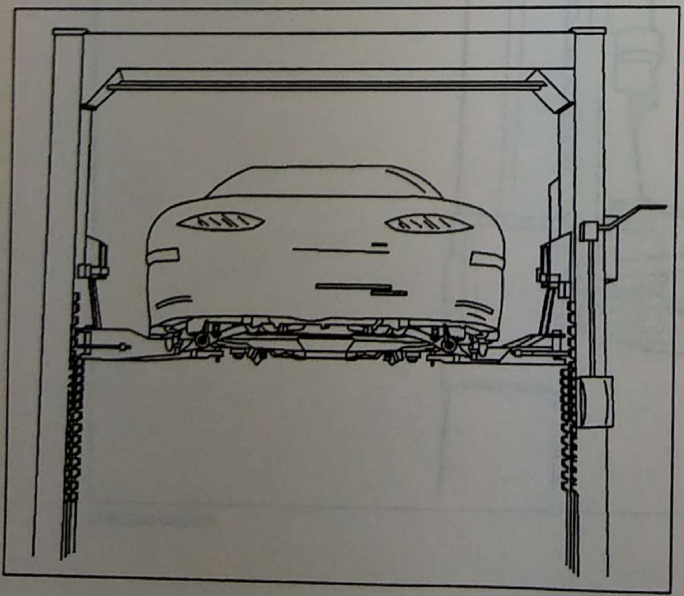
2. Move lift arms under the vehicle and adjust the pads to the bottom of the pinch weld flange at specified lift locations.



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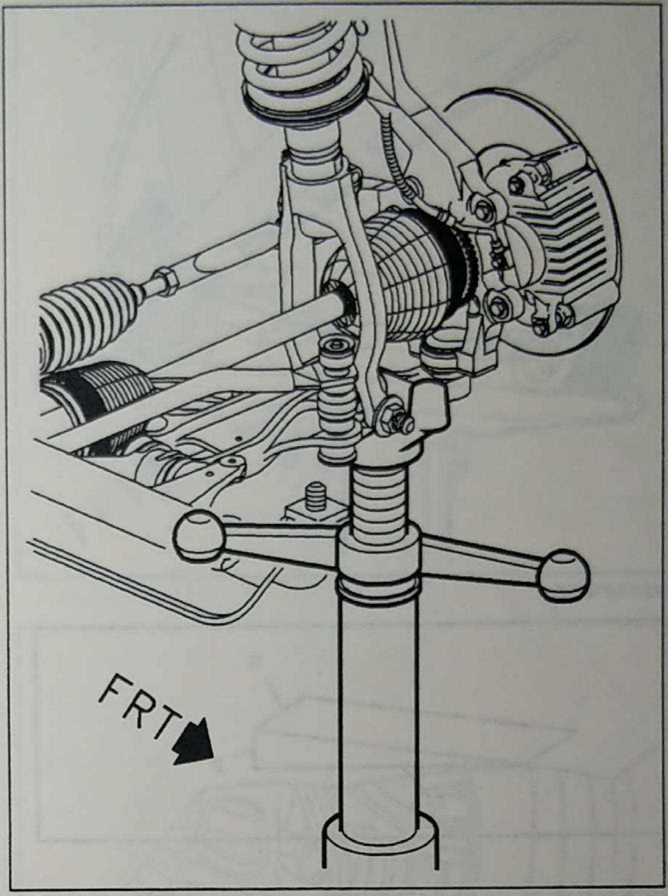
3. Raise the vehicle to the required working height.

4. Position safety stands in place.



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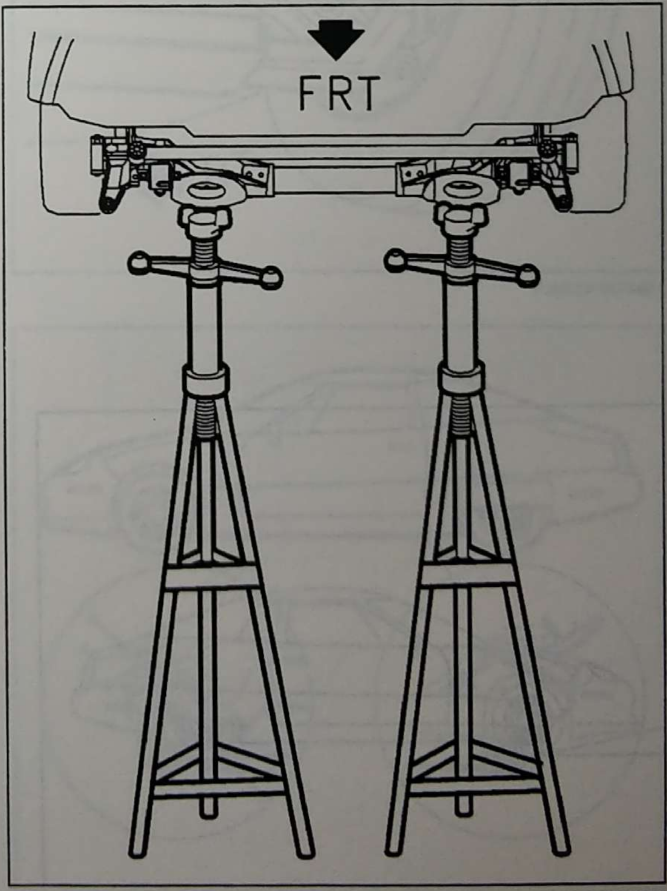

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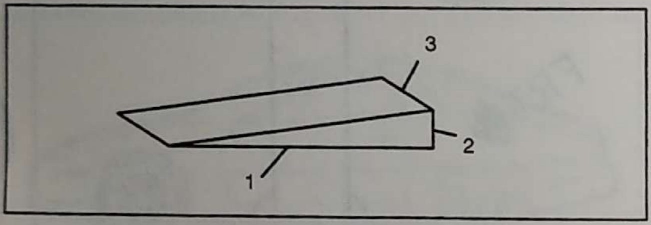
HOISTING/LIFTING FOR A 2 POST INGROUND HOIST – (FRONT AND REAR)

CAUTION: BEFORE ENTERING THE AREA UNDER A RAISED VEHICLE ALWAYS CHECK TO MAKE SURE HOIST SAFETY MECHANISMS ARE ENGAGED OR LIFT SAFETY STANDS ARE IN PLACE.

NOTICE: When using an in ground hoist it is necessary to pay close attention to the ground clearance at the front end of the vehicle. Be careful not to damage any of the front end components.

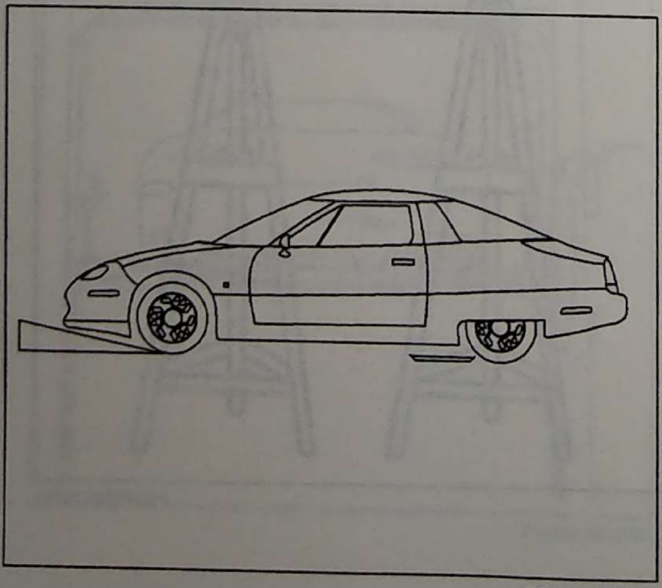
NOTICE: The aid of a ramp for some models of lifts is helpful for obtaining clearance under the front end of the vehicle. Proper clearance will keep the fascia and underbody components from being damaged when approaching or leaving the hoisting area. Ramp size needed:



1. **1050 mm in length (41-3/8 in.)**
2. **155 mm in width (6-7/64 in.)**
3. **230 mm in height (9-1/16 in.)**

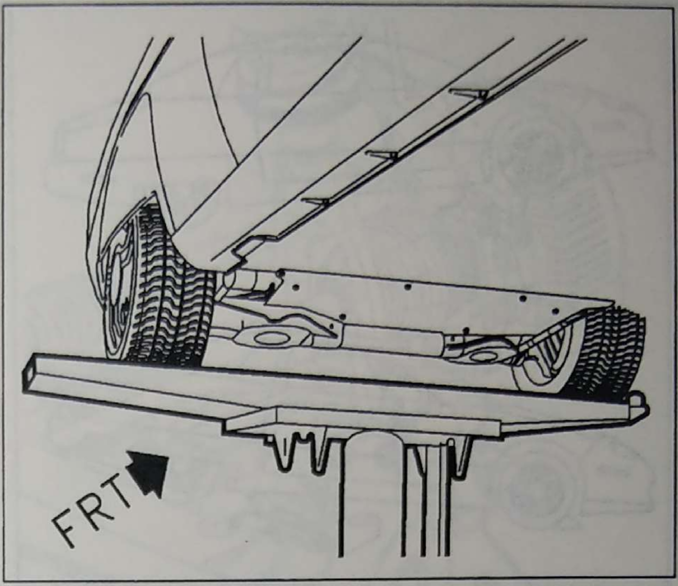
NOTICE: With the use of ramps, always have a partner who will be outside and in front of the vehicle guide and watch to ensure that proper alignment is achieved to the ramps and hoisting area. Be careful that you don't drive over or slip off the edge of the ramps. Failure to do so could result in damage to under body and mechanical components.

NOTICE: The first vehicle to be lifted using the ramp method may take several attempts to get properly aligned to the hoist pads under the front of the body structure. Marking the floor with tape, paint or permanent marker after the ramp position is determined will aid in the positioning ramps for future EV1 vehicle lifting.



1. Drive the vehicle up to the hoisting area, centering the vehicle to the hoist in its side to side position.
2. Drive vehicle forward until the front of the rear tires contact the rear edge of the rear tire lift tray.
3. Place the ramps on the floor. In front of the vehicle, center each ramp in front of the front tires.
4. Slide ramps rearward until they touch the front of the front tires, or align ramps to markings on floor made from previous lifting as described in the above "NOTICE."

5. Drive forward and up the ramps until the rear tires are centered in the rear tire tray portion of the hoist.



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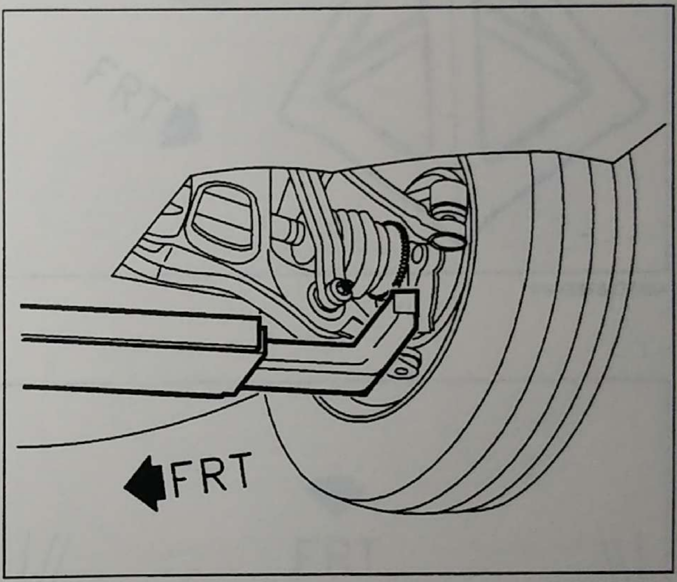
6. Put the front lift pads under the vehicle's front lower control arms at the portion between the ball joint and the yoke.
7. Lift the vehicle to proper working height and position safety stands. (Refer to "Lifting, Jacking, and Support Points" and "Hoisting Lifting with a Floor Jack" sections in this section.)



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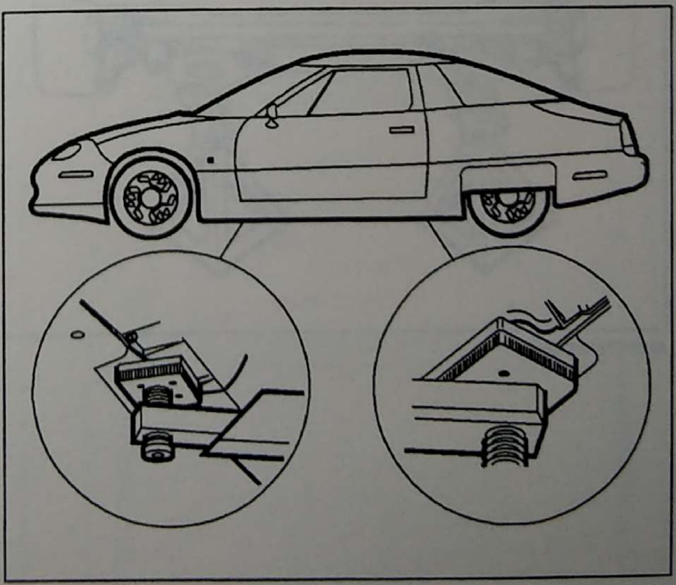
LIFTING WITH A FLOOR JACK

NOTICE: Do not put floor jack under any portion of the vehicle other than locations shown or damage to the structure may occur.

1. Locate the rocker panel pinch weld flange lift/hoist areas, place floor jack in position, seat the lift pad in place, and chock the wheels. (Refer to "General Information" in the "Lifting, Jacking, and Support Points" section in this section.)



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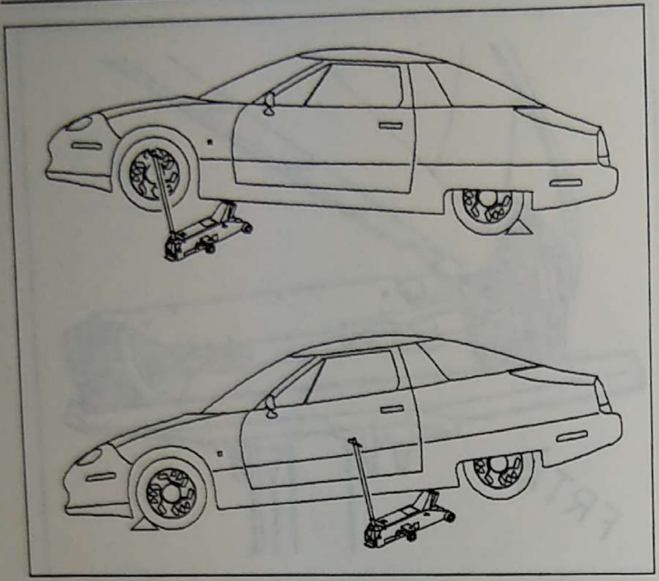

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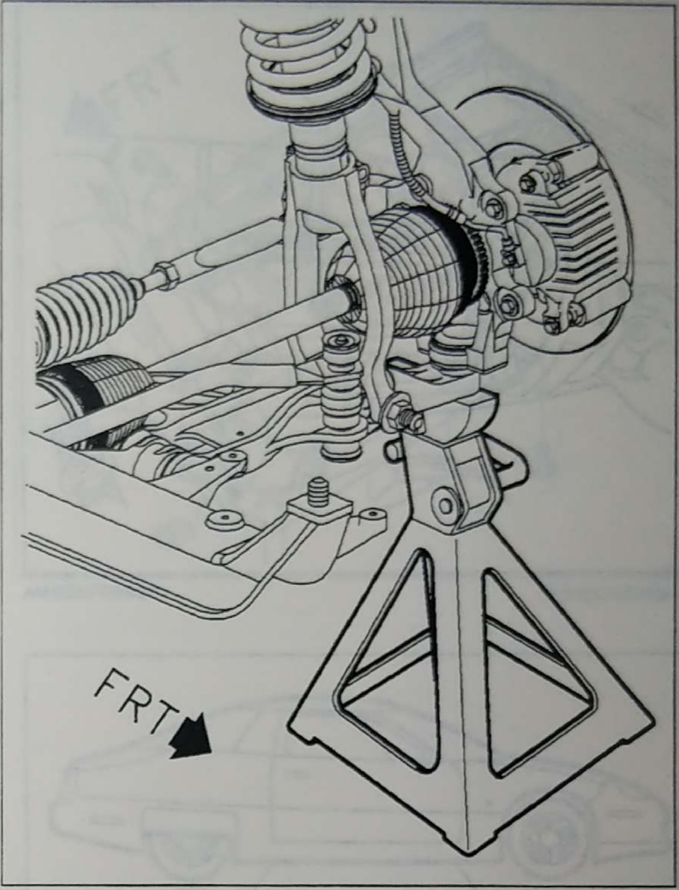
CAUTION: TO HELP AVOID PERSONAL INJURY, ALWAYS USE JACK STANDS WHEN WORKING ON OR UNDER ANY VEHICLE THAT IS LIFTED BY A FLOOR JACK OR A HOIST.

2. Lift vehicle with floor jack.

3. Once the vehicle is at the required working height install safety stands.



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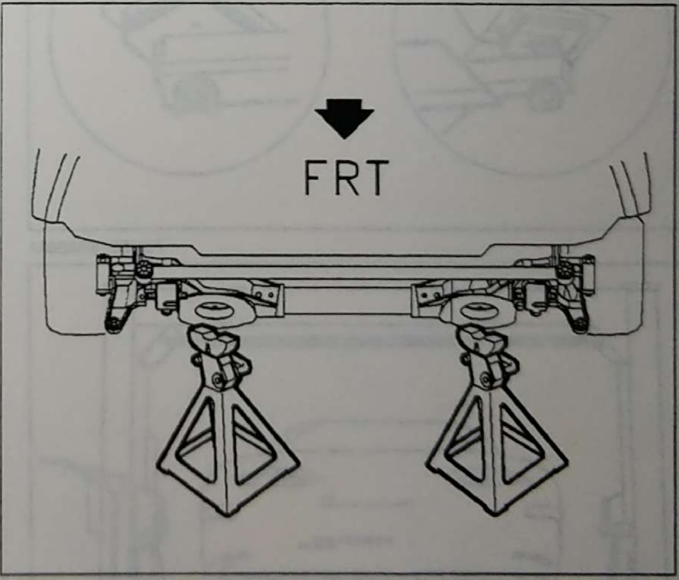

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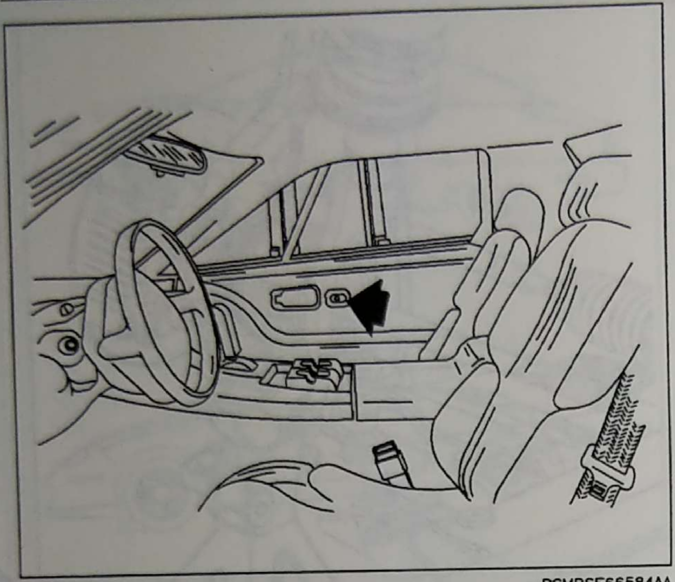

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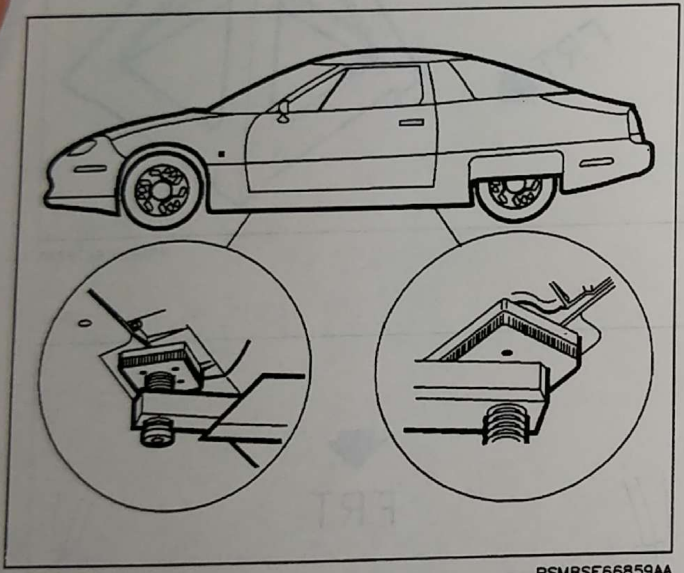

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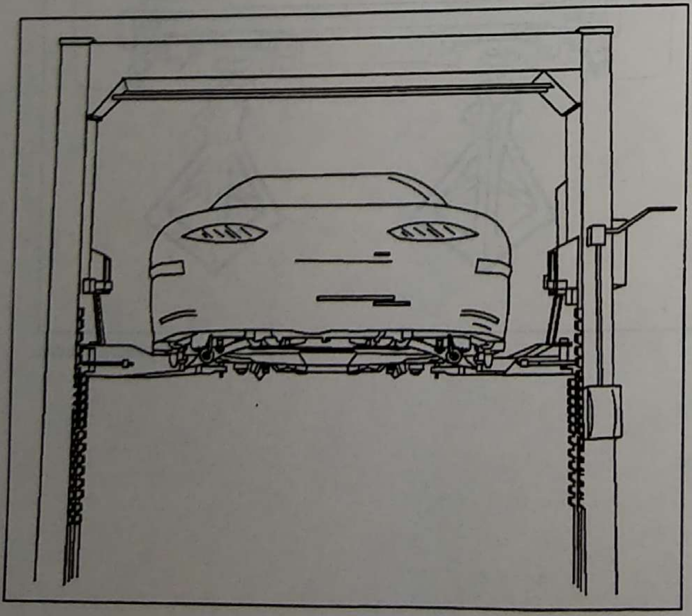

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HOISTING/LIFTING FOR BATTERY PACK REMOVAL/INSTALLATION WITH ABOVE GROUND HOIST – (SIDE CAR)

CAUTION: TO HELP AVOID PERSONAL INJURY, ALWAYS USE JACK STANDS WHEN WORKING ON OR UNDER ANY VEHICLE THAT IS LIFTED ONLY BY A FLOOR JACK OR A HOIST.

CAUTION: BEFORE ENTERING THE AREA UNDER A RAISED VEHICLE ALWAYS CHECK TO MAKE SURE HOIST SAFETY MECHANISMS ARE ENGAGED OR LIFT SAFETY STANDS ARE IN PLACE.

1. Position the vehicle in the hoisting area centering the vehicle between the towers. To center the vehicle to the hoist in its fore aft position, use the door lock switch on the door trim pad as a reference.

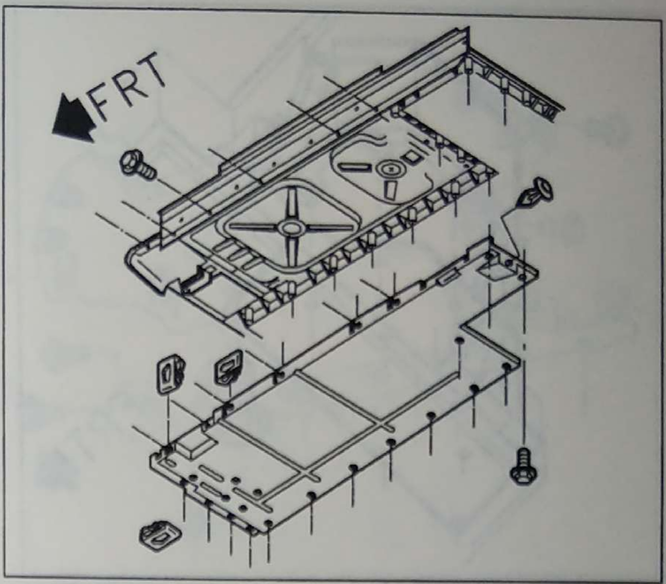
IMPORTANT: Different hoist manufacturers require specific lift pad adapters, refer to General Motors Dealer Equipment for your specific application.

2. Place rear lift pad adapters for battery pack removal on hoist arms as shown.
3. Move front lift arms under the vehicle and adjust the pads to contact specific lift points.
4. Move rear lift arms under vehicle and adjust pads to clear outside edge of pinchweld and align guide pin hole in structure at specified lift points.
5. Raise the vehicle to working height and position safety stands in place. (For more information on safety stand placement refer to “Lifting, Jacking and Support Points” in this manual.)

UNDERBODY CENTER AIR DEFLECTORS

REMOVAL (LEFT OR RIGHT SIDE)

1. Raise vehicle on hoist. (Refer to "Lifting, Jacking, and Support Points" section in this manual.)
2. Remove six bolts retaining underbody front air deflector to underbody center air deflector.
3. Remove two bolts from trap door location on front underbody air deflector.
4. Remove four bolts retaining underbody center air deflector to rocker outer finish panel.
5. Remove one bolt retaining underbody center air deflector to front fender.
6. Remove ten bolts retaining center air deflector to battery pack tray.
7. Lower and remove underbody center air deflector from vehicle.



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INSTALLATION

IMPORTANT: If bolt threads or "J" nuts threads are damaged during installation, remove bolt and fastener, inspect, and replace if necessary.

1. Raise and support underbody center air deflector to underside of vehicle.
2. Install front edge of underbody center air deflector above rear edge of underbody front air deflector.
3. Loose install six bolts retaining underbody center air deflector to underbody front air deflector.
4. Loose install two bolts retaining underbody center air deflector to trap door location.

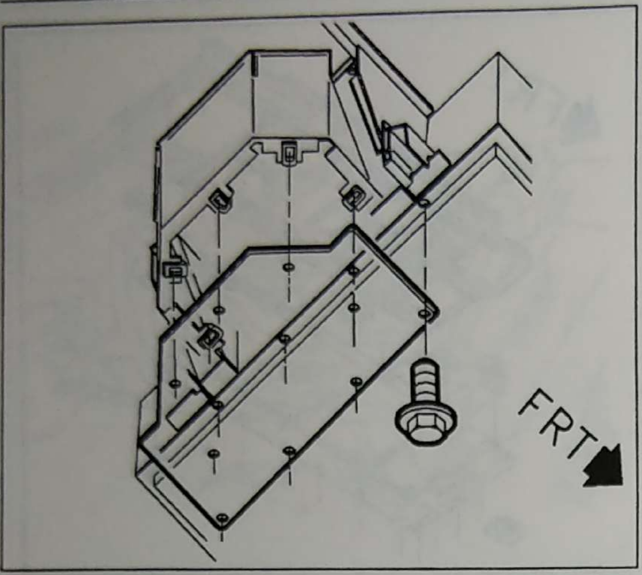
IMPORTANT: If bolt begins to cross thread during installation in the battery tray, stop immediately, remove bolt, then run thread tap (M6.0 mm x 1.0) into insert to repair damaged threads.

5. Loose install ten bolts retaining underbody center air deflector to battery pack tray.
6. Check and align rocker outer finish panel to door lower edge. Install five bolts retaining underbody center air deflector to rocker outer finish panel. Torque as specified.

Torque: **6 N•m (53 in–lbs)**

7. Torque all remaining bolts as specified.

Torque: **6 N•m (53 in–lbs)**



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UNDERBODY CENTER REAR AIR DEFLECTOR

REMOVAL

1. Raise vehicle on hoist. (Refer to “Lifting, Jacking, and Support Points” section in this manual.)
2. Remove four bolts retaining underbody center rear air deflector from battery pack tray.
3. Remove five bolts retaining underbody center rear air deflector to underbody center air deflector bracket.
4. Lower and remove underbody center rear air deflector from vehicle.

INSTALLATION

1. Raise and support underbody center rear air deflector to underbody center rear air deflector bracket assembly.

IMPORTANT: If bolt begins to cross thread during installation in the battery tray, stop immediately, remove bolt, then run thread tap (M6.0 mm x 1.0) into insert to repair damaged threads.

2. Loose install four bolts retaining underbody center rear air deflector to battery pack tray.

IMPORTANT: If bolt threads or “J” nuts threads are damaged during installation, remove bolt and fastener, inspect, and replace if necessary.

3. Install five bolts retaining underbody center rear air deflector to underbody center air deflector bracket assembly. Torque as specified.

Torque: 6 N•m (53 in–lbs)

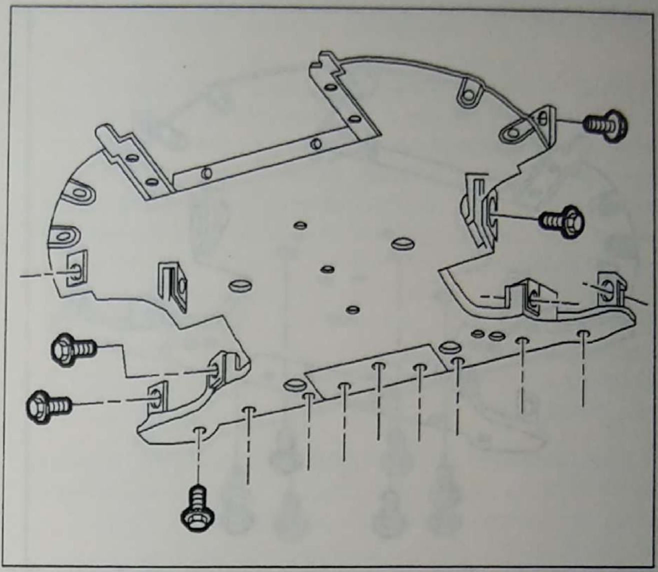
4. Torque all remaining bolts as specified.

Torque: 6 N•m (53 in–lbs)

UNDERBODY FRONT AIR DEFLECTOR

REMOVAL

1. Raise vehicle on hoist. (Refer to "Lifting, Jacking, and Support Points" section in this manual).
2. Remove bolts retaining underbody front air deflector to underbody center air deflectors.
3. Remove bolts retaining underbody front air deflector to front wheelhouse panel liners.



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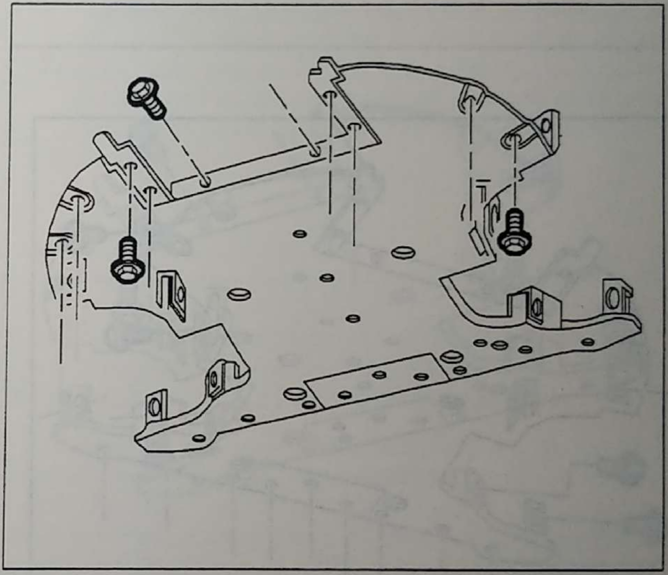
4. Remove bolts retaining underbody front air deflector to front bumper fascia assembly.
5. Remove bolts retaining underbody front air deflector to condenser radiator fan module (CRFM) bracket.
6. Remove bolts retaining underbody front air deflector to side baffles.



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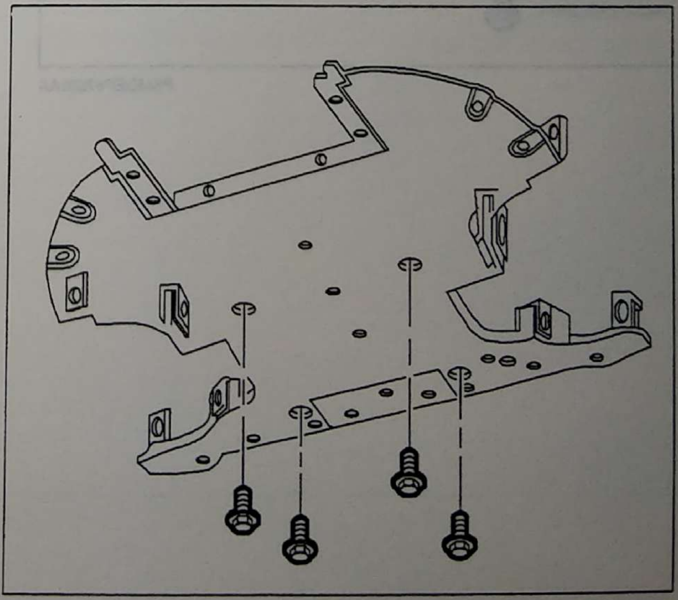
7. Remove bolts retaining underbody front air deflector to drivetrain and front suspension crossmember assembly.
8. Lower underbody front air deflector and disengage tabs from front bumper fascia assembly.



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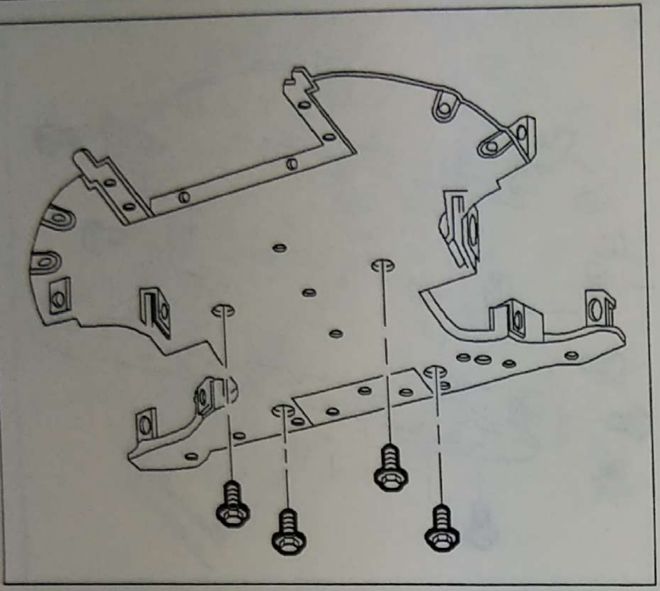

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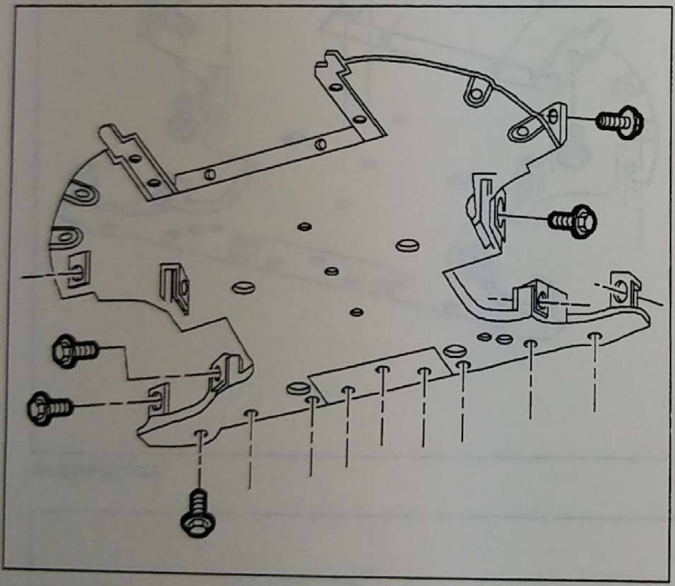

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INSTALLATION

IMPORTANT: If bolt threads or "J" nuts threads are damaged during removal or installation, remove bolt and fastener, inspect, and replace if necessary.

1. Raise front edge of air deflector and engage tabs into retaining slots on front bumper fascia assembly.
2. Raise and support underbody front air deflector to underside of vehicle.

IMPORTANT: Flange on air deflector must be located forward of Condenser Radiator Fan Module (CRFM) bracket.

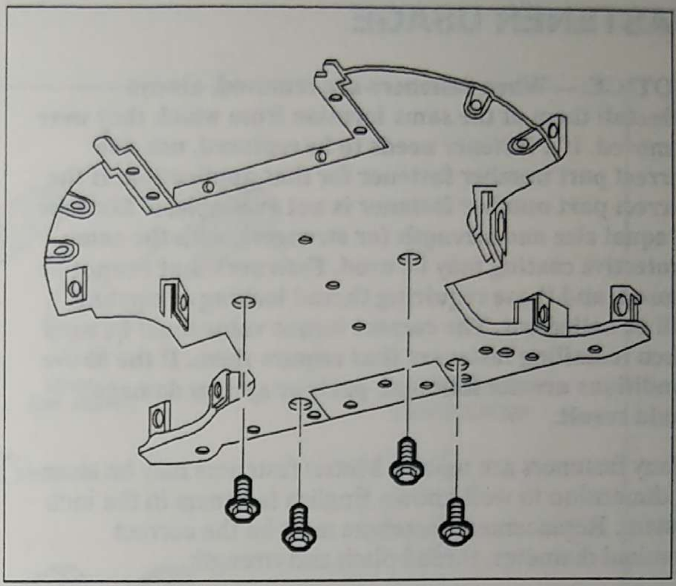
3. Loosely install bolt retaining air deflector to CRFM bracket.
4. Loosely install bolts retaining underbody front air deflector to front mounting locations of drivetrain and front suspension crossmember assembly.
5. Loosely install bolts retaining underbody front air deflector to rear mounting locations of drivetrain and front suspension crossmember assembly.
6. Install and tighten bolts retaining underbody front air deflector to underbody center air deflectors. Torque as specified.

Torque: **6 N•m (53 in–lbs)**

IMPORTANT: If cradle bolt begins to cross thread during installation, stop immediately, remove bolt, then run thread tap (M6.0 mm x 1.0) into insert to repair damaged threads.

7. Tighten bolts retaining underbody front air deflector to front mounting locations of drivetrain and front suspension crossmember assembly. Torque as specified.

Torque: 6 N•m (53 in–lbs)



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IMPORTANT: At CRFM attachment, position air deflector flange so that it rests up against the bottom of the CRFM lower support.

8. Install and tighten bolt retaining underbody front air deflector to CRFM bracket. Torque as specified.

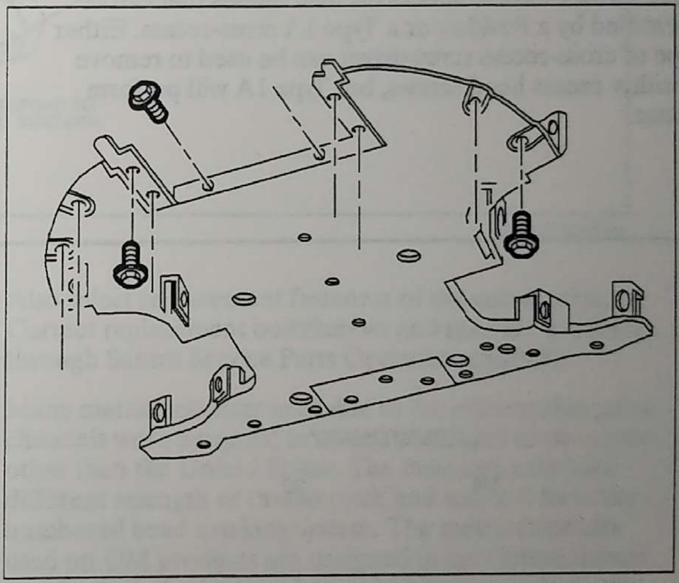
Torque: 6 N•m (53 in–lbs)

9. Tighten remaining bolt retaining air deflector to CRFM bracket. Ensure underbody front air deflector is up against bottom of CRFM lower support. Torque as specified.

Torque: 6 N•m (53 in–lbs)

10. Install and tighten bolts retaining underbody front air deflector to CRFM to fascia close-out side baffles. Torque as specified.

Torque: 6 N•m (53 in–lbs)



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11. Install and tighten bolts retaining underbody front air deflector to front bumper fascia assembly. Torque as specified.

Torque: 6 N•m (53 in–lbs)

12. Install and tighten bolts retaining underbody front air deflector to front wheelhouse panel liner on one side of the vehicle. Front tires may need to be rotated to access mounting locations. Torque as specified.

Torque: 6 N•m (53 in–lbs)

13. Install and tighten bolts retaining underbody front air deflector to front wheelhouse panel liner on opposite side of the vehicle. Front tires may need to be rotated to access mounting locations. Torque as specified.

Torque: 6 N•m (53 in–lbs)

14. Lower vehicle and turn front wheels to face in a straight ahead position.

FASTENER USAGE

NOTICE: **When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger), with the same protective coating may be used. Fasteners that cannot be reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require them. If the above conditions are not followed, parts or system damage could result.**

Many fasteners are metric. Metric fasteners may be close in dimension to well-known English fasteners in the inch system. Replacement fasteners must be the correct nominal diameter, thread pitch and strength.

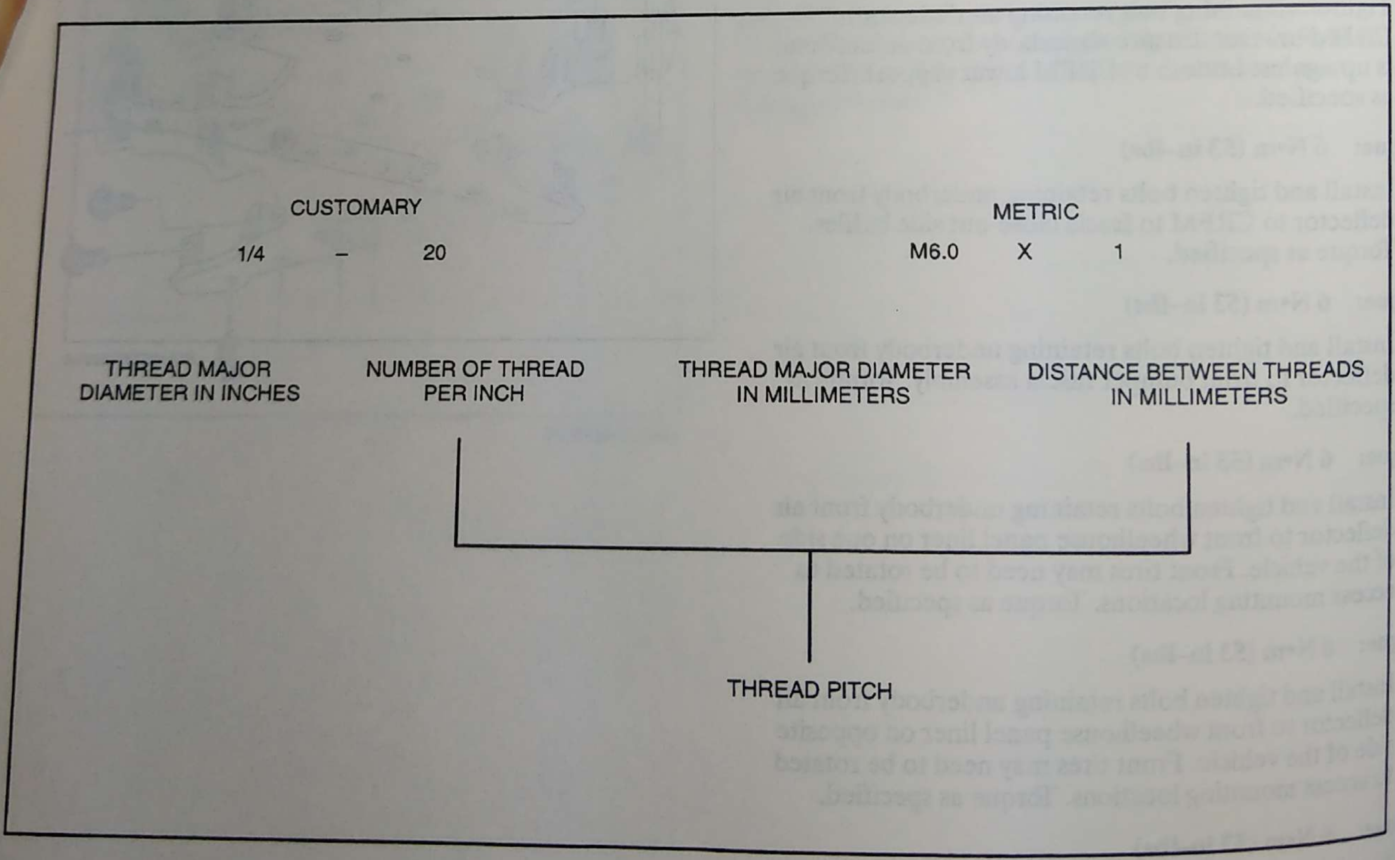
Original equipment metric fasteners, except for exposed bumper bolts and other beauty bolts and cross-recess head screws, have numbers on their heads that can be identified by a Posidriv or a Type 1A cross-recess. Either type of cross-recess screwdriver can be used to remove Posidriv recess head screws, but Type 1A will perform better.

NOTICE: **Most metric fasteners have a blue color coating. This coating should not be used to positively identify fasteners because not all metric fasteners are color-coated. Damage to the fastener or part could result if a English fastener is incorrectly used to replace a metric fastener.**

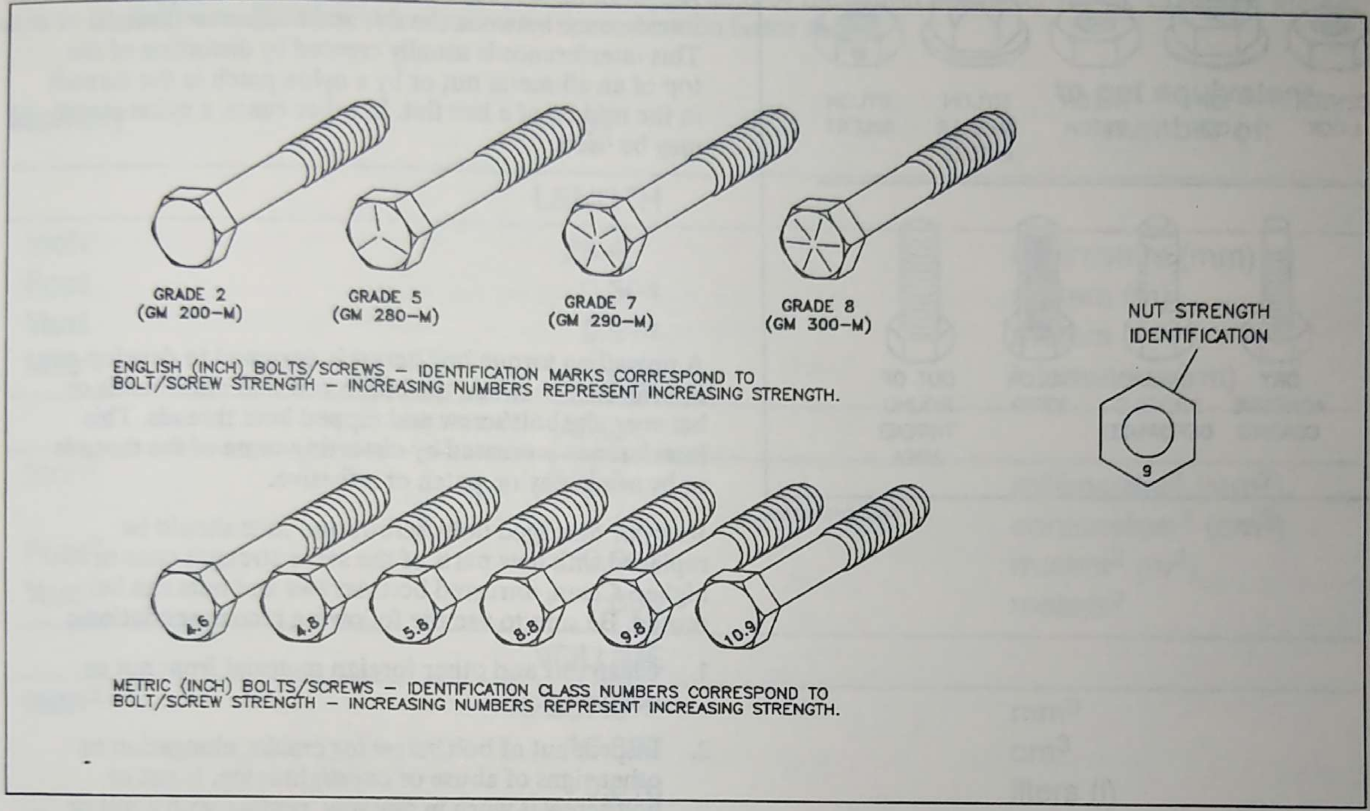
Metric and English thread notations differ slightly. For example, the thread major diameter of a 1/4-20 bolt/screw is 1/4 inch, and the bolt /screw has 20 threads per inch. The thread major diameter of an M6.0x1 bolt/screw is 6.0 mm, and the bolt/screw has a 1 mm between threads.

Many aluminum components are used on present GM models. Aluminum in contact with steel may corrode rapidly if not protected by special finishes or isolators. There are three special finishes which meet GM specifications; they are GM 6111-M (gray), GM 6047 (black) or GM 6147-M (black). These special fasteners differ in color from the standard metric fasteners, which are medium blue, in order to make them easily identifiable.

NOTICE: **When replacing fasteners avoid substituting otherwise similar fasteners in locations which require the use of GM 6111-M, GM 6047, or GM 6147-M type special fasteners for aluminum components. Failure to follow this precaution may result in premature corrosion of sheet metal or fastener.**


CUSTOMARY
1/4 – 20
METRIC
M6.0 X 1
THREAD MAJOR DIAMETER IN INCHES
NUMBER OF THREAD PER INCH
THREAD MAJOR DIAMETER IN MILLIMETERS
DISTANCE BETWEEN THREADS IN MILLIMETERS
THREAD PITCH

FASTENER STRENGTH IDENTIFICATION



ENGLISH (INCH) BOLTS/SCREWS – IDENTIFICATION MARKS CORRESPOND TO BOLT/SCREW STRENGTH – INCREASING NUMBERS REPRESENT INCREASING STRENGTH.

METRIC (INCH) BOLTS/SCREWS – IDENTIFICATION CLASS NUMBERS CORRESPOND TO BOLT/SCREW STRENGTH – INCREASING NUMBERS REPRESENT INCREASING STRENGTH.

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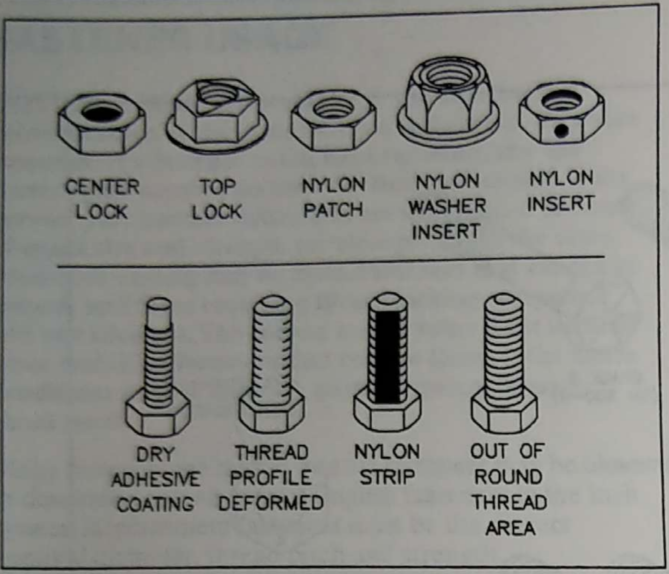
Most commonly used metric fastener strength property classes are 9.8 and 10.9. The class identification is embossed on the head of each bolt/screw. English fastener strength property classes range from grade 2 to 8. Radial lines are embossed on the head of each bolt/screw to identify the strength class. Some metric nuts are marked with strength identification numbers on the nut face.

When replacing fasteners, be careful to use bolts/screws and nuts of a strength class equal to, or higher than, the original fasteners (the same number marking or higher).

Also select replacement fasteners of the correct size. Correct replacement bolts/screws and nuts are available through Saturn Service Parts Operation (SSPO).

Many metric fasteners available in the aftermarket parts channels were designed to metric standards of countries other than the United States. The fasteners may have different strength or thread pitch and may not have the numbered head marking system. The metric fasteners used on GM products are designed to new international standards that might not be used by some nondomestic bolt/screw and nut suppliers.



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PREVAILING TORQUE FASTENERS

A prevailing torque nut is designed to develop a interference between the nut and bolt/screw threads. This interference is usually created by distortion of the top of an all-metal nut or by a nylon patch in the threads in the middle of a hex flat. In other cases, a nylon insert may be used.

A prevailing torque bolt/screw is designed to develop an interference between the bolt/screw and nut threads or between the bolt/screw and tapped hole threads. This interference is created by distorting some of the threads or by using a nylon patch or adhesive.

Rusty or damaged bolts/screws and nuts should be replaced with new parts of the same strength class or higher. Clean, unrusted bolts/screws and nuts can be reused. Be sure to use the following recommendations:

1. Clean dirt and other foreign material from nut or bolt/screw.
2. Inspect nut of bolt/screw for cracks, elongation or other signs of abuse or overtightening. If nut or bolt/screw is worn in any way, replace with a nut or bolt/screw of the same strength class or higher.
3. Assemble the parts and hand-start nut or bolt-screw.
4. Check that nut or bolt/screw fails to develop the proper torque before it seats. If nut or bolt/screw fails to develop torque correctly, replace with a nut or bolt/screw of the same strength class or higher.
5. Tighten fastener to the torque specified in the appropriate installation procedure in this manual.

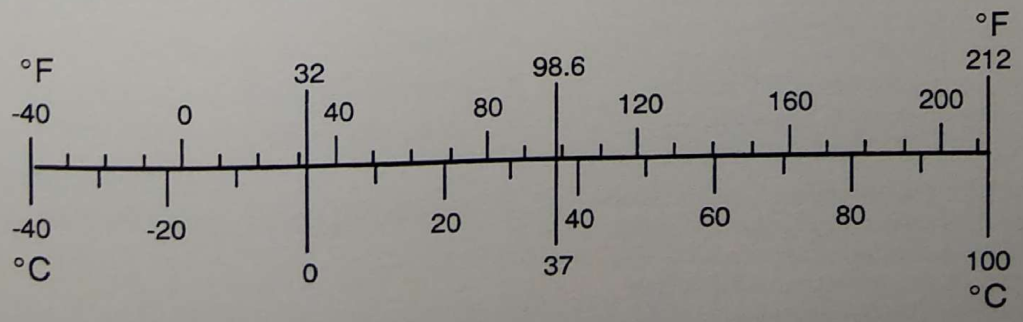
FASTENER TYPE	TORQUE UNITS	METRIC-SIZE FASTENERS							
		6	6.3	8	10	12	14	16	20
NUTS AND ALL METAL BOLTS/SCREWS	N•m	0.4	0.4	0.8	1.4	2.2	3.0	4.2	7.0
	Lb. In.	4	4	7	12	19	27	37	62
ADHESIVE OR NYLON COATED BOLTS/SCREWS	N•m	0.4	0.4	0.6	1.2	1.6	2.4	3.4	5.6
	Lb. In.	4	4	5	11	14	21	30	50
FASTENER TYPE	TORQUE UNITS	INCH-SIZE FASTENERS							
		.250	.312	.375	.437	.500	.562	.625	.750
NUTS AND ALL METAL BOLTS/SCREWS	N•m	0.4	0.6	1.4	1.8	2.4	3.2	4.2	6.2
	Lb. In.	4	5	12	16	21	28	37	55
ADHESIVE OR NYLON COATED BOLTS/SCREWS	N•m	0.4	0.6	1.0	1.4	1.8	2.6	3.4	5.2
	Lb. In.	4	5	9	12	16	23	30	49

CS CamScanner

ENGLISH-METRIC CONVERSIONS

To convert English units to Metric units, multiply the English units by the conversion factor shown. To convert Metric units to English units, divide the Metric units by the conversion factor shown.

Multiply	**by**	**to get equivalent number of:**
	LENGTH	
Inch	25.4	millimeters (mm)
Foot	0.304	meters (m)
Yard	0.914	meters
Mile	1.609	kilometers (km)
	AREA	
Inch^2	645.2	millimeters^2 (mm^2)
	6.45	centimeters^2 (cm^2)
Foot^2	0.092	meters^2 (m^2)
Yard^2	0.836	meters^2
	VOLUME	
Inch^3	16 387.0	mm^3
	16.387	cm^3
	0.016	liters (l)
Quart	0.946	liters
Gallon	3.785	liters
Yard^3	0.764	meters^3 (m^3)
	MASS	
Pound	0.453	kilograms (kg)
Ton	907.18	kilograms (kg)
Ton	0.907	tonne (t)
	FORCE	
Kilogram	9.807	newtons (N)
Ounce	0.278	newtons
Pound	4.448	newtons
	TEMPERATURE	
Degree Fahrenheit (°F)	(°F-32) ÷ 1.8	Degree Celsius (C)



CS CamScanner

ENGLISH-METRIC CONVERSIONS (CONTINIED)

Multiply	by	to get equivalent number of:
ACCELERATION		
Foot/sec^2	0.305	meter/sec^2 (m/s^2)
Inch/sec^2	0.025	meter/sec^2
TORQUE		
Pound-inch	0.113	newton-meters (N•m)
Pound-foot	1.356	newton-meters
POWER		
Horsepower	0.746	kilowatts (kW)
PRESSURE OR STRESS		
Inches of water	0.248	kilopascals (kPa)
Pounds/sq. in.	6.895	kilopascals
ENERGY OR WORK		
BTU	1 055.	joules (J)
Foot-pound	1.356	joules
Kilowatt-hour	3 600 000. or 3.6 x 10^6	joules (1 joule = one watt–second)
LIGHT		
Foot candle	10.76	lumens/meter^2 (lm/m^2)
FUEL PERFORMANCE		
Miles/gal	0.425	kilometers/liter (km/l)
Gal/mile	2.353	liter/kilometer (l/km)
VELOCITY		
Miles/hour	1.609	kilometers/hr. (km/h)

BATTERY PACK MODULE – SYMPTOM DIAGNOSIS

PRELIMINARY CHECKS

ON-BOARD DIAGNOSTICS CHECK

This should be the starting point of any driveability or symptom diagnosis. Perform the on-board diagnostics (OBD) check as defined in this manual. This check verifies the integrity of the battery pack module (BPM) and its self-diagnostic capabilities. If diagnostic trouble codes (DTCs) are stored, go directly to the numbered DTC chart.

VERIFY COMPLAINT

Verify the customer complaint and locate the correct symptom definition. Check all of the items associated with that symptom in both the complaint/condition charts and symptom tables.

GATHER INFORMATION

Gather information from all resources available to pinpoint the "when," "where," "why," and "how" of the symptom. Road test with the customer when possible to completely understand the symptom. Compare the symptom to a similar vehicle to verify this is an abnormal condition. Find out (when applicable), maintenance history, typical driving cycle, charging habits, etc. Perform a bulletin search focusing on specific symptoms.

VISUAL INSPECTION

The importance of the visual inspection cannot be overstressed. Visual inspection can lead to correcting a problem without further testing and can save valuable time. The check should include:

- Use of aftermarket equipment (e.g., alarm systems, cellular phones, lighting, CB radio, etc.).
- Inspect wiring harnesses for proper routing, connections, pinches, chaffing and cuts.
- Inspect grounds for tightness and evidence of corrosion.

SECTION 1 – DIAGNOSTIC INFORMATION

VISUAL/PHYSICAL UNDERHOOD INSPECTION

A careful visual and physical underhood inspection must be performed as part of any diagnostic procedure or in finding the cause of a failure. This can often lead to fixing a problem without further steps. Inspect all hoses for correct routing, pinches, cuts or disconnects. Inspect all wires in the motor compartment for proper connections, burned or chafed spots, pinched wires, or contact with sharp edges. This visual/physical inspection is very important. It must be done carefully and thoroughly.

KNOWLEDGE AND TOOLS REQUIRED

To use this manual most effectively, a general understanding of basic electrical circuits and circuit testing tools is required. One should be familiar with wiring diagrams, the meaning of voltage, ohms, amps, frequency, the basic theory of electricity, and understand what happens in an open or shorted wire.

To perform system diagnosis, the use of a diagnostic Scan tool is required. A tachometer, test light, digital ohmmeter with 10 megohms impedance, and jumper wires are also required. Please become acquainted with the tools and their use before attempting to diagnose a vehicle.

DIAGNOSTIC INFORMATION

The diagnostic trouble tree charts and functional checks in this manual are designed to locate a faulty circuit or component through logic based on the process of elimination. The charts are prepared with the requirement that the vehicle functioned correctly at the time of assembly and that there are no multiple failures. Trouble tree charts are designed to be used only when a diagnostic trouble DTC is active.

The propulsion control module (PCM) performs self-diagnostics of propulsion control functions. The PCM communicates faults with a system of diagnostic trouble DTCs (DTCs). These DTCs may or may not turn on a telltale.

DTC TEST DESCRIPTIONS

The Scan tool will display whether the DTC in the PCM's memory is current or history. The following describes the current/history criteria for each DTC.

Current – A current DTC indicates that the last time a diagnostic test was performed on a particular system or sub-system it failed. For DTCs indicated as latched for ignition cycle, a problem may no longer exist, but the DTC will not clear until vehicle has been powered off/on. A current status will remain between Run cycles if fault is present for other DTCs.

History – A history DTC indicates there have been enough faults detected to determine a problem exists. Diagnostic trouble DTCs that are calibrated to turn On telltales on the first occurrence, DTCs will be stored in history as soon as a fault becomes current.

It is important to remember that the DTC as well as any stored malfunction history will be erased if the vehicles battery has been disconnected, or a clear DTC command is issued to the PCM. DTCs and malfunction history records will also be erased if 100 power transfercycles have been recorded without any faults.

MALFUNCTION RECORDS

With most faults, excluding battery module faults, the battery pack module (BPM) stores vehicle information into a memory called related data. This information is data for a DTC that caused the DTC to set. The Saturn portable diagnostic tool (PDT) displays this information in the DTC MENU under the MALFUNCTION HISTORY directory as failure record. Malfunction history records the same data plus additional information and stores it in failure records numbered one through five. When the total recorded failures exceeds five the last stored failure will be removed and the most recent installed as #5.

DTC NUMBER:

- # of Power Transfer (PT) cycles of most current fault
- # of Power Transfer (PT) cycles since last occurrence fault.
- # of Power Transfer (PT) cycles since first occurrence fault
- PACK VOLTAGE
- PACK CURRENT
- MAXIMUM PACK TEMPERATURE
- ACCESSORY VOLTAGE
- VEHICLE SPEED
- VEHICLE STATE: SHUTDOWN/PROPEL/CHARGE/STANDBY/SUPPORT
- PACK COOL COMMAND (Fan PWM value)
- APS VOLTAGE COMMAND (High/Low)
- VEHICLE RUN (True/False)
- PRECONDITION
- PARK SELECT (True/False)
- VEHICLE WAKE-UP COMMAND (True/False)
- USER STATE OF CHARGE (USOC)

CHARGER EVENT HISTORY RECORDS

The battery pack module (BPM) also contains a Charging event history table. The will store the table after each charging event. The BPM will maintain the last four recorded charging events in Charger history. This information can be used to aid in diagnosing vehicle/charging interface problems.

- SEASON ODOMETER
- POWER TRANSFER CYCLE SINCE LAST CHARGE
- MILES SINCE LAST CHARGE
- BASE CHARGE COMPLETION CRITERIA: *(FAULT, COUPLER REMOVED, % RETURN, NORMAL, MINIMUM POWER, CHARGER OR BPM FAULT)*
- LENGTH OF BASE CHARGE EVENT
- UNCOMPENSATED AMP HOURS USED SINCE LAST CHARGE
- UNCOMPENSATED AMP HOURS RETURNED DURING CHARGING
- BATTERY PACK VOLTAGE AT START
- BATTERY PACK VOLTAGE MAX
- PACK CURRENT END OF BASE CHARGE
- BATTERY PACK STATE OF CHARGE (PSOC) *START: END:*
- LEVELING (YES/NO)
- LEVELING % COMPLETE
- BATTERY PACK TEMP. START:
- BATTERY PACK TEMP. MAX:
- BATTERY PACK COOLING REQUEST: (YES/NO)
- TEMP. RESTRICTION AFFECTING CHARGE TIME:
- POWER RESTRICTION AFFECTING CHARGE TIME:
- MIN. CHARGE POWER: KW
- MAX CHARGE POWER: KW
- CHARGER I.D.: (8–DIGIT)

UPDATING DTCS GREATER THAN FIVE

When five BPM DTCs are set and the sixth fault occurs, the first four DTCs set will remain and the last DTC will be updated with the new DTC (sixth DTC). If additional DTCs set the first four DTCs will remain as the originals and the last DTC will update for each fault.

POWER TRANSFER CYCLE

A power transfer cycle is like an Ignition cycle except it is defined as any time the vehicle reads .5 amps charging or discharging.

READING DIAGNOSTIC TROUBLE DTCS

The provision for communicating with the BPM is the data link connector (DLC). It is located under the instrument panel. It is used in the assembly plant to receive information in checking that the propulsion system is operating properly before it leaves the plant.

The diagnostic trouble DTC(s) stored in the BPM's memory can be read only through a hand-held diagnostic Scan tool plugged in the DLC connector when the vehicle is turned On.

CLEARING DIAGNOSTIC TROUBLE DTCS

Clearing diagnostic trouble DTCs is accomplished by choosing the "Clearing Trouble DTCs" option in the Scan tool DTC menu. BPM history DTCs can only be cleared when vehicle is in Run mode, park and not charging. Disconnecting the battery for 60 seconds (and in some cases longer) will clear DTCs, active and history from the BPM's memory. Malfunction history records will also be cleared.

ON-BOARD DIAGNOSTIC SYSTEM CHECK (OBD SYSTEM CHECK)

After the visual/physical underhood inspection, the on-board diagnostic system check (OBD check) is the starting point for all diagnostic procedures or finding the cause of a test failure.

The correct procedure to diagnose a problem is to follow three basic steps:

1. Are the on-vehicle diagnostics working? This is determined by performing the on-board diagnostic system check (OBD check). Since this is the starting point for the diagnostic procedures or finding the cause of test failure, always begin here.
2. Is there a diagnostic trouble DTC stored? If a diagnostic trouble DTC is stored, go directly to the numbered diagnostic trouble DTC chart. This will determine if the fault is still present. If no diagnostic trouble DTC is stored, proceed to the next step.
3. Scan serial data transmitted by the BPM. This involves reading the information available on the serial data stream with one of the tools available for that purpose. The meaning of the various displays can be found in the Scan tool data definition section. Expected readings under a particular operating condition can also be found in the Scan tool data definition section.

DLC SCAN TOOLS

The propulsion control module (PCM) can communicate a variety of information through the data link connector (DLC). This data is transmitted at a high-frequency which requires a Scan tool for interpretation. There are several Scan tools available for reading this information.

With an understanding of the data which the tool displays, and knowledge of the circuits involved, the tool can be very useful in obtaining information which would be more difficult or impossible to obtain with other equipment.

Scan tools do not make the use of diagnostic charts unnecessary, nor can they indicate exactly where a problem is in a particular circuit. Trouble DTC diagnostic charts incorporate diagnosis procedures using a Scan tool where possible and most charts require the use of a Scan tool when it is applicable.

The Scan tool has the ability to save time in diagnosis and prevent the replacement of good parts. The key to using the Scan tool successfully for diagnosis lies in the technician's ability to understand the system being diagnosed, as well as an understanding of the Scan tools operation and limitations. The technician should read the tool manufacturer's operating manual to become familiar with the tool's operation.

SCAN TOOL USAGE WITH INTERMITTENTS

In some Scan tool applications, the data update rate makes the tool less effective than a voltmeter, such as when trying to detect an intermittent problem which lasts for a very short time. However, the Scan tool does allow one to manipulate wiring harnesses or components under the hood with the vehicle in the Run mode, while observing the readout of the Scan tool.

The Scan tool can be plugged in and observed while driving the vehicle under the condition when a telltale lamp turns On momentarily or when propulsion is momentarily poor. An assistant should be used when driving a vehicle and using a Scan tool. If the problem seems to be related to certain parameters that can be checked on the Scan tool, they should be checked while driving the vehicle. If there does not seem to be any correlation between the problem and any specific circuit, the Scan tool can be checked on each position, watching for a period of time to see if there is any change in the readings that would indicate intermittent operation.

The Scan tool is also an easy way to compare the operating parameters of a poorly operating system with those of a known good one. For example, a sensor may shift in value but not set a diagnostic trouble DTC. Comparing a sensor's readings with those of a known good vehicle may uncover the problem.

The BPM has the ability to take a snapshot when a diagnostic trouble DTC is stored. This information can be found with a Saturn Scan tool (portable diagnostic tool [PDT]), listed under Malfunction history. This information can be very useful when attempting to troubleshoot intermittent diagnostic trouble DTCs.

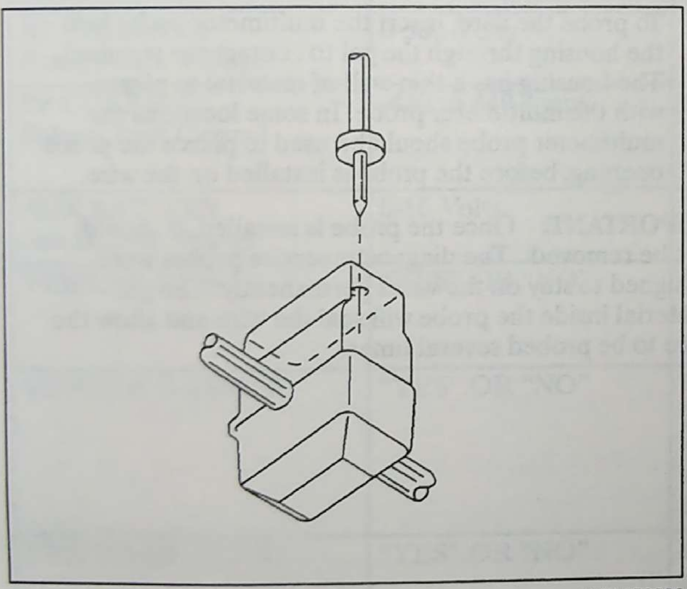
DIAGNOSTICS USING THE DIAGNOSTIC SERVICE PROBE

DIAGNOSTIC SERVICE PROBE

IMPORTANT: Diagnostic service probes are for use on .35, .50 and .80 mm (22, 20 and 18 gage) wires only.

IMPORTANT: The diagnostic service probes must be left on the wire after use. The probe contains a sealant that will protect the wire from corrosion. Do not remove the diagnostic service probe after use.

The use of the diagnostic service probe offers many advantages in system diagnostics over the old *jumper wire* and *terminal back-probe* methods. The most important advantage of the diagnostic service probe method of diagnostics is the ability to observe the operation of a circuit without disturbing the components or connections. This is an important advantage since many circuit failures are vibration or connection related. The diagnostic service probe is designed to firmly hold multimeter test probes to allow more accurate readings while the circuit is operating. Circuits with bad connectors, grounds or components are easier to diagnose while they are operating.



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Attach the diagnostic service probe to the wire leading to the connector and insert your multimeter into the diagnostic service probe. Put the meter on the appropriate scale and observe the readings. If the readings do not compare with the expected readings, gently wiggle the wire back and forth in the connector. If the reading on the meter changes while you are wiggling the wire, the terminal or connector are faulty. Disconnect the connector and examine the terminals and connector cavities for damage. Check the terminals to see if a known good terminal makes a firm connection. Do this by inserting a known good male terminal into the female terminal you are testing. The male terminal should be held firmly in place by the female terminal and should not be loose enough to fall out if the female terminal is held downward. Likewise, test a male terminal by inserting it into a known good female terminal. The two terminals should fit snugly together and should not separate if the male terminal is held vertically downward.

If the connections are good (both wire connections and the connection to the component), check the ground connection. Attach a diagnostic service probe to the ground side of the circuit or component. Place a multimeter probe in the diagnostic service probe and the other probe to a known good ground.

Place the multimeter on the lowest ohmmeter scale.

NOTICE: Check the accuracy of the multimeter first by touching the leads together. The meter should read less than 0.10 ohm with the leads touching.

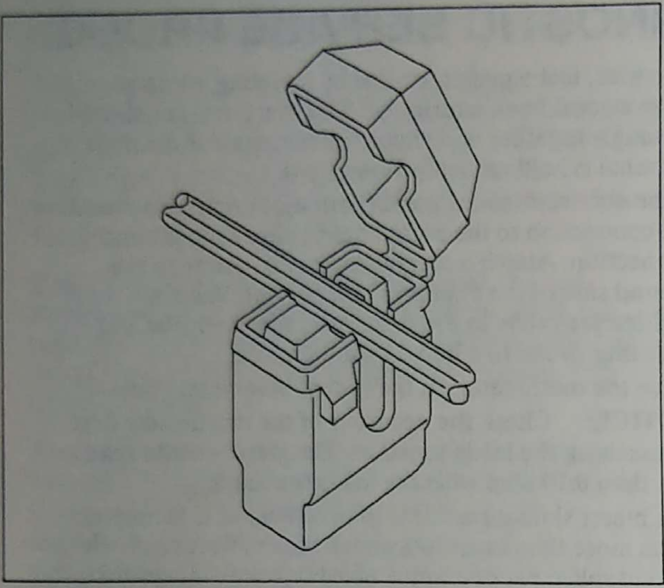
The meter should read less than one ohm. If the meter reads more than one ohm, check the connections to the ground splice pack (if applicable) or check the ground attachment point. Attach a jumper wire from the ground attachment ring terminal. Attach it to the ring terminal without moving or disturbing the terminal fastener. This can be done by attaching the jumper wire to the crimp lead part of the ring terminal. Attach the other end of the jumper wire to a known good ground and watch the multimeter to see if the reading goes below one ohm. If the reading goes below one ohm, remove the ground screw or nut, clean the connection surfaces and install. If the reading stays above one ohm, check for an open in the ground wire. Also check for continuity from the component to the diagnostic service probe.

Other uses for the diagnostic service probe:

- Compare voltage readings across connectors, components, or lengths of wire. This allows you to observe the operation of a circuit without the addition of jumper wires or back-probing connections. The best time to diagnose most circuits is while they are operating.
- Observe changing voltages and compare them to what the battery pack module (BPM) is reporting. This can be done by comparing the voltage readings of the BPM inputs to the reported BPM readings displayed on the portable diagnostic tool (PDT) or the service stall system (SSS). This can help detect damaged or faulty BPM connections, or a faulty BPM.

IMPORTANT: There are differences between the actual voltages from the sensors and the reported voltages by the BPM. This is due to the internal conversion of these voltages to binary data by the BPM. However, the voltages should generally vary together and the difference should be less than 0.2 volt.

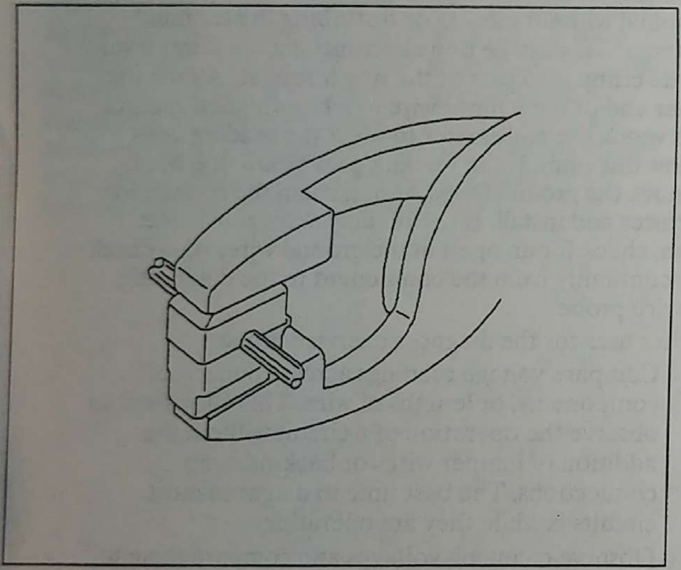
- The diagnostic service probe can be used with future test equipment to gain access to a circuit for testing or calibration.
- The diagnostic service probe can be used to give a good ground access point. Attach a diagnostic service probe to a ground circuit and insert the multimeter lead in the probe at a ground reference. Check the ground circuit to verify the ground path is good.



SMELC50824AA

INSTALLATION

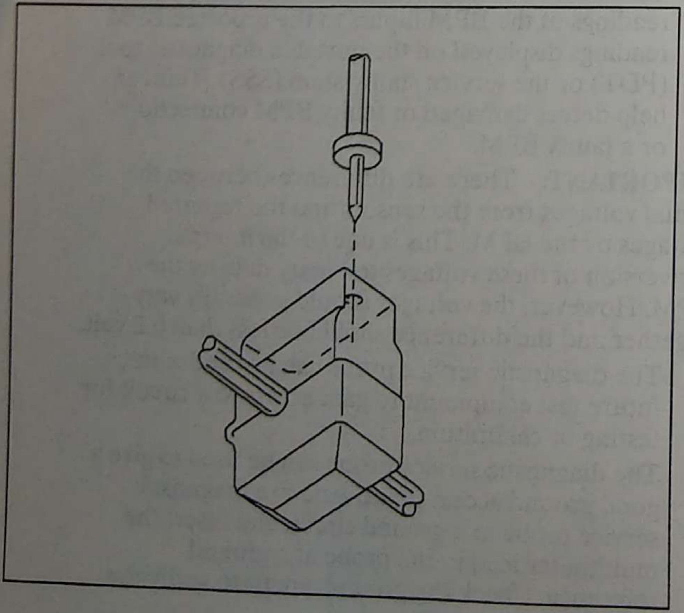
1. Place the cable into the V-slot of the terminal.
2. Press the cable into the V-slot by hand and initiate closing the cover.



SMELC50825AA

3. Close the cover completely by pressing the cable into the diagnostic service probe terminal with pliers until the cover locks shut. A snap should be felt or heard when the cover locks.
4. To probe the wire, insert the multimeter probe into the housing through the gel to contact the terminal. The housing has a thin wall of material to pierce with the multimeter probe. In some locations the multimeter probe should be used to pierce the probe opening, before the probe is installed on the wire.

IMPORTANT: Once the probe is installed, it should not be removed. The diagnostic service probes were designed to stay on the wires permanently. The gel material inside the probe will seal the wire and allow the wire to be probed several times.



SMELC50826AA

EV SCANNER-BPM		
S/W INFORMATION		
S/W ID	XXXXXXXX	Displays the 8-digit number for identifying the software of the BPM.
EE PROG	"YES" OR "NO"	Displays Yes if reprogramming.
ROM CHECKSUM	XXXX	Displays the BPM checksum.
BATTERY MODULE VOLTAGE		
#1-26 BATTERY MODULES	0-17 Volts	Displays the current voltage of each battery module. If a battery reads a constant 13 volts no matter what the amp draw, the value has been defaulted by the BPM.
BP TEMPS/AIRFLOW		
#1-6 BP TEMP	-18°C to 66°C (.4°F to 150.8°F)	Displays the temperature at six locations within the battery pack. Temperature sensors are located on battery modules #1, 3, 4, 6, 9, 10.
BP AIRFLOW	0-100%	Displays the amount of airflow going through the battery pack as seen by the airflow sensor.
BP INLET TEMP	-18°C to 66°C (.4°F to 150.8°F)	Displays the temperature of the air entering the battery pack via the fan and thermal system.
AUTO DISC/VOLT INFO		
BP VOLT-SUM Battery Pack Voltage	0-500 Volts	Displays the voltage of the battery pack. The voltage is the result of the sum of all 26 modules.
BP CURRENT Battery Pack Current	-440 to 440 Amps	Displays the current flowing in the battery pack that is used for control purposes. The current is measured at the shunt in the battery pack. Positive current = charging.
AUX BATTERY Aux Battery Voltage	0-16 Volts	Displays the value of aux battery voltage the BPM is receiving.
VEHICLE RUN 1	"YES" OR "NO"	Displays YES when the battery pack module (BPM) has received Run 1 from the RSA. Run 1 is not active during charging.
VEHICLE WAKEUP	"YES" OR "NO"	Displays YES when the HPVS/thermal control module (HTCM) or charge receptacle have commanded the wake-up line. HPVS/thermal control module (HTCM) commands wake-up line for aux battery charging and thermal system operation.
VEH WAKEUP CMD	"YES" OR "NO"	Displays YES when the battery pack module (BPM) has asserted the wake-up line to the HPVS/thermal control module (HTCM) and accessory AC and DC power module (APM) for aux battery charging.
POWER DOWN	"YES" OR "NO"	Displays YES when the battery pack module (BPM) has commanded the hardware to power down. This will take place as soon as all external hardware inputs will permit.
PARK SELECT	"YES" OR "NO"	Displays YES when the drive motor PRND is in Park. This is read by a discrete line to the battery pack module (BPM) from the PRND switch.
APS VOLT COMD	High OR Low	Displays one of the two levels the battery pack module (BPM) is requesting for the accessory AC and DC power module (APM) to provide output power to the 12 volt system. High = 14.5 volts, Low = 13.5 volts.
BP FAN CMD ON	"YES" OR "NO"	Displays YES when the battery pack fan has been commanded On by the battery pack module (BPM).

EV SCANNER-battery pack module (BPM)		
BP FAN SPD CMD	0-100%	Displays the speed at which the battery pack module (BPM) has commanded the fan to run. The signal is a pulse width modulated (PWM).
CR TEMP W/COUPLER Charge Receptacle Temperature	0°C to 100.5°C (32°F to 212.9°F)	Displays the temperature of the charge receptacle during charging. The temperature value will read 0°C (32°F) when the charge coupler is not inserted in the charge receptacle.
CR TEMP OPEN Charge Receptacle Temperature Sensor Open	"YES" OR "NO"	Displays YES when the battery pack module (BPM) has detected an open in the charge receptacle temperature sensor.
CR TEMP SHORT Charge Receptacle Temperature Sensor Short	"YES" OR "NO"	Displays YES when the battery pack module (BPM) has detected a short in the charge receptacle temperature sensor.
AD CMD Auto Disconnect Command	"NORMAL" OR "INHIBIT" OR "DISCONNECT"	Displays the command to the auto disconnect to take action. **NORMAL** = The AD may open the relays as required in any fault condition. **INHIBIT** = The AD may open the relays in any fault condition except an isolation fault. **DISCONNECT** = Command from the battery pack module (BPM) to open the relays.
AD STATE Auto Disconnect State	"NORMAL" OR "FAIL" OR "COMMAND" OR "LOOP" OR "PRECHARGE" OR LOW–V" OR "GROUND" OR "ISOLATION" OR "PS–FAIL" or "INVALID"	Displays the present state of the auto disconnect. **NORMAL** = The relays are closed, battery pack power is available at the power inverter module (PIM). **FAIL** = (AD precharge fault) The AD was unsuccessful in precharging the high voltage bus in the required time. The relays are open. **COMMANDED** = battery pack module (BPM) has commanded AD to open relays. **LOOP** = (interlock loop) The AD has detected a failure in the interlock loop circuit. **PRECHARGE** = The AD is precharging the bus to enable closing of the relays. **LOW VOLTAGE** = The AD has detected a low battery pack voltage. **GROUND** = The AD has detected a shift or loss of ground. **ISOLATION** = The AD has detected a high voltage (HV) isolation fault. **PS FAIL** = (power supply failure) The battery pack module (BPM) has detected a failure of the AD power supply. **INVALID** = The AD state cannot be determined.
BP CHARGE STATUS		
PRND MODE	"PARK" OR "REVERSE" OR "NEUTRAL" OR "DRIVE" OR "ERROR"	Displays the propulsion control module's understanding of the drive motor gear selector position. The propulsion control module (PCM) decodes the PRND switch and reports the information over serial data.
PARK SELECT	"YES" OR "NO"	Displays YES when the PBM descrete indicates the PRND is in the Park position.
propulsion control module (PCM) COUPLER IN	"YES" OR "NO"	Displays YES when the propulsion control module (PCM) has reported to the battery pack module (BPM) via serial data that the charge coupler is present in the charge receptacle.

EV SCANNER-battery pack module (BPM)		
NO COOLANT	"YES" OR "NO"	Displays YES when the HPVS/thermal control module (HTCM) has reported coolant level too low to cool the charge receptacle and battery pack module (BPM) will disable charging.
HPVS/thermal control module (HTCM) REGEN	ENABLE OR DISABLE	Displays DISABLE when the HPVS/thermal control module (HTCM) has detected a over-temperature failure. battery pack module (BPM) will disable charging.
APS FAILURE	"YES" OR "NO"	Displays YES when the HPVS/thermal control module (HTCM) has detected a failure of the APS.
BP CURR FAULT Battery Pack Current Fault	"YES" OR "NO"	Displays YES when the battery pack module (BPM) has detected a problem with reading the current.
BP TEMP FAULT Battery Pack Temperature Fault	"YES" OR "NO"	Displays YES when the battery pack module (BPM) has detected a fault in the temperature sensing circuitry that cannot be compensated for.
BP VOLT FAULT	"YES" OR "NO"	Displays YES when the battery pack module (BPM) has detected a number of battery module voltages are incorrect.
CR OV TEMP FAULT Charge Receptacle Over Temperature Fault	"YES" OR "NO"	Displays YES when the battery pack module (BPM) has detected a over temperature condition in the charge receptacle.
CR TEMP MALF Charge Receptacle Temperature Malfunction	"OK" OR "OPEN" OR "SHORT" OR "INVALID"	Represents the charge receptacle has a fault that will prevent charging. **OK** = Charge coupler present, no CR power supply fault is present. **OPEN** = CR temperature circuit is open OR a CR power supply fault is present. **SHORT** = CR temperature circuit is shorted. **INVALID** = CR temperature cannot be determined.
CHRG MODE Charge Transfer Mode	"STANDBY" OR "READY" OR "TRANSFER" OR "FAULT"	**STANDBY** = Conditions for power transfer have not been met. **READY** = Conditions for power transfer have been met. Power transfer control process active. **TRANSFER** = The battery pack module (BPM) is requesting power from the charger. **FAULT** = A condition has occurred that is not acceptable for power transfer.
VEHICLE READY	"YES" OR "NO"	Displays YES when the charge coupler is inserted in the charge receptacle and the vehicle is in a state to support charging/preconditioning.
VEHICLE RUN	"YES" OR "NO"	Displays YES when the battery pack module (BPM) has received the Run 1 from the RSA command.
VEHICLE WAKEUP	"YES" OR "NO"	Displays YES when the battery pack module (BPM) has received a wakeup signal from the HPVS/thermal control module (HTCM).
CHRG COMMUNICATION Charger Communication Detected	"YES" OR "NO"	Displays YES when the battery pack module (BPM) is receiving messages over class II from the charger.
BP CURRENT DET Battery Pack Current Detected	"YES" OR "NO"	Displays YES when the battery pack module (BPM) detects current above a certain level.

EV SCANNER-battery pack module (BPM)		
battery pack module (BPM) WAKEUP REQ battery pack module (BPM) Periodic Wakeup Request	“YES” OR “NO”	Displays YES when the HPVS/thermal control module (HTCM) has asserted the vehicle wakeup line due to a previous request by the battery pack module (BPM).
PROP MODE Propulsion Mode	“PROPEL” “STANDBY” “CHARGE” “ENDCHG” “PRECON” OR “SHUTDOWN”	Represents the operational mode of the vehicle as determined by the battery pack module (BPM). **STANDBY** = Mode not yet determined **PROPEL** = Motoring/regenerating **CHARGE** = Charging and/or preconditioning **ENDCHG** = Shut down charging **PRECON** = Preconditioning only no charging **SHUTDOWN** = Functional process complete
CHRG STATE Charge State	“CHARGING” “RESET” “FLOATING” “FAULT” “UPDATING” OR “EQUALIZING”	Represents the present or last operational state of charging as determined by the battery pack module (BPM). **RESET** = Reset any charge faults previously detected. **CHARGING** = Normal charging. **FLOATING** = Float charge. Maintain present charge of battery pack (BP). **UPDATING** = Updating the charge status of BP. **EQUALIZING** = Equalization charging **FAULT** = Charging failed due to no control.
VEHICLE ID		
VIN	XXXXXXXXXXXXX XXXXXXXX	Vehicle identification number (VIN).
END MODEL NO.	XXXXXXXXXXXX	Displays the end model number of the battery pack module (BPM).
BASE MODEL NO.	XXXXXXXXXXXX	Displays the base model number of the battery pack module (BPM).
HARDWARE ID	X	Displays the hardware ID number of the battery pack module (BPM).
SERIAL NUMBER	XXXXXXXX	Displays the serial number of the battery pack module (BPM).
MFG YEAR	XXXXXXXXXX	Displays the year when the battery pack module (BPM) was manufactured.
JULIAN DATE	XX	Displays the Julian date when the battery pack module (BPM) was manufactured.
MODULE PART NO.	XXXXXXXXX	Displays the module part number of the battery pack module (BPM).
CAPACITY/CAPABILITY		
AGE PACK CAP Age Compensated BP Capacity	0-100 amp-hours	Displays the battery pack module (BPM) calculated age compensated battery pack capacity.
AMP HRS USED	0-100 amp-hours	Displays the number of amp hours that have been used since the pack was full charged. Resets on each charge complete.
SELF DSCHRG LOSS	0-100 amp-hours	Displays the amount of amp-hours that have been lost from the battery pack due to self discharging of the battery modules.
COMP CUMM CHG	0-2,000,000 amp-hours	Displays the compensated cumulative amp hours that have been put into the battery pack from charging.
CUMU CHRG	0-2,000,000 amp-hours	Displays the cumulative amp hours that have been removed from the battery pack.

EV SCANNER-battery pack module (BPM)		
AGE FCTR DYNAMIC AGE FACTOR	0.0 to < 2.00	Displays the factor being used to adjust the pack capacity based on the age of the battery pack.
CNTR DSG TIME Estimated Center Discharge Time	0.0 seconds	Displays the estimated elapsed time from the center of the discharge to now.
BAT MOD RESIS Estimated Battery Module Resistance	0 to < 0.05 Ohms	Displays the estimated value of the battery module resistance.
AH WT FCTR	0.0 to < 2.00	Displays the value used to initialize the amp hour weight factor.
AVG I WT FCTR	0.0 to < 2.00	Displays the value used to initialize the average current (amps) weight factor.
LST ACPC CUM DSCHG	0-2,000,000 amp-hrs	Displays the value of the cumulative discharge when the last age compensated pack capacity was done.
LST ACPC MILES	XXXXXX.X KM	Display the miles when the last age compensated pack capacity was done.
LST EQU CUM DSCHG	0-2,000,000 amp-hrs	Displays the value of the cumulative discharge at the end of the last equalization charge.
PK CAPABILITY	0-100 amp-hours	Displays the present remaining amp-hours (capability) in the battery pack if it was discharged at 25 amps, at 27°C (80°F) to a battery module voltage of 10.5 volts.
PACK CAPACITY	0-100 amp-hours	Displays the maximum BP capability (amp-hrs) when fully charged and f discharge took place at 25 amps, 27°C (80°F) to a battery module voltage of 10.5 volts.
PARASITIC AH LST	0-100 amp-hours	Displays the amount of amp-hours that have been removed from the battery pack due to parasitic losses.
PEUKERT CAPB	0.0 to < 32.0	Displays the gain factor used to determine the battery pack capability.
SEL BAT MOD	Low−Mod−1 Low−Mod−2 Low−Mod−3 Pack−Volt	Displays which voltage and current values will be used to calculate the voltage based state of charge.
VSOC	0-100%	Displays the value of the vehicle state of charge (VSOC) which has not been compensated for temperature or stand time of the vehicle.
CHARGING INFO		
BP VOLT SUM	0-500 Volts	Displays the sum of the 26 module voltages as calculated by the battery pack module (BPM).
BP VOLTAGE	0-461.3	Displays the battery pack voltage as measured by the battery pack module (BPM).
CHRG PWR REQ	0-100%	Displays the maximum percentage of charger output power request.
AVG BP TEMP	-18°C to 66°C	Displays the average temperature as calculated by the battery pack module (BPM) using all valid battery module temperature sensors.
BP CURRENT ACTUAL	-440 to 440 amps	Displays the present current flowing through each of the battery modules as measured at the shunt.
BP CURRENT	-440 to 440 amps	Displays the current flowing in the battery pack that should be used for control purposes. If a fault is detected this value will be defaulted. Positive current charges the battery modules.

EV SCANNER-battery pack module (BPM)		
SOC CURRENT	-440 to 440 amps	Displays the current flowing in the battery pack that should be used for the calculation of state of charge (SOC).
BP TEMP	-18°C to 66°C	Displays the temperature used for battery pack module (BPM) control purposes.
MAX CONTROL V	0-500 volts	Displays the maximum voltage to which charging is controlled.
MAX CONTROL I	-440 to 440 amps	Displays the maximum current to which charging is controlled.
CHG STATE	"CHARGING" "RESET" "UPDATING" "EQUALIZING" "FLOATING" OR "FAULT"	Represents the present or last operational state of charging as determined by the battery pack module (BPM). **RESET** = Reset any charge faults previously detected. **CHARGING** = Normal charging. **UPDATING** = Updating the charge status of BP. **EQUALIZING** = Equalization charging. **FAULT** = Charging failed due to no control.
battery pack module (BPM) FAULTS AND HISTORY RECORDS		
CURRENT DTCs		Represents the failures the battery pack module (BPM) sees as active now.
HISTORY DTCs		Represents the failures the battery pack module (BPM) has seen but are not currently active.
MALF HISTORY DATA		
1st Fault DTC		Represents the diagnostic trouble code (DTC) number of the fault.
# of Occurrences	XX	Represents number of times the diagnostic trouble code (DTC) has occurred.
CYCLE SINCE LAST	XX	Represents number of power transfer cycles since the last time the diagnostic trouble code (DTC) occurred.
CYCLE SINCE FIRST	XX	Represents number of power transfer cycles since the first time the diagnostic trouble code (DTC) occurred.
VEHICLE STATE	"STANDBY" "CHARGE" "PROPEL" "SUPPORT" OR "SHUTDOWN"	Represents the operational mode of the vehicle as determined by the battery pack module (BPM). **STANDBY** = Mode not yet determined. **CHARGE** = Charging is currently taking place. **PROPEL** = Motoring/Regeneration **SUPPORT** = Supporting vehicle operations only. **SHUTDOWN** = Functional process shutting down.
VEHICLE RUN	"YES" OR "NO"	Displays YES when the battery pack module (BPM) has received the Run 1 from the run/lock shifter assembly (RSA) command.
VEHICLE WAKEUP	"YES" OR "NO"	Displays YES when the battery pack module (BPM) has received a wakeup signal from the HPVS/thermal control module (HTCM).
APS VOLT CMD Accessory Power Supply Voltage Command	"LOW" OR "HIGH"	Displays HIGH when the battery pack module (BPM) has commanded the accessory AC and DC power module (APM) to output at 14.5 volts. LOW = 13.5 volts.
PARK SELECT	"YES" OR "NO"	Displays YES when the drive motor PRND is in Park. This is read by a discrete line to the battery pack module (BPM) from the PRND switch.

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EV SCANNER-battery pack module (BPM)		
PSOC Pack State of Charge	0-100%	Displays the percentage of pack state of charge when the fault occurred. 15% pack state of charge (PSOC) = 0%. User state of charge (USOC).
SPD XX MPH XX KPH Vehicle Speed	0-162	Displays vehicle speed at the time the fault occurred.
BP VOLT SUM	0-500 Volts	Displays the sum of the 26 module voltages as calculated by the battery pack module (BPM).
BP CURRENT Battery Pack Current	-440 to 440 amps	Displays the current flow when the fault occurred. Note: Positive current charges the batteries.
BP TEMP Battery Pack Temperature	-18°C to 66°C (-4°F to 150.8°F)	Displays the temperature used for battery pack module (BPM) control purposes.
AUX BATTERY Aux Battery Voltage	0-16 Volts	Displays the aux battery voltage as seen by the battery pack module (BPM).
BP FAN SPD	0-100%	Displays the % duty cycle for the battery pack fan control.
CHRG EVENT HIST		
ODOMETER (KM)	XXXXXXX.X	Displays the miles at the start of the charging event.
DIS LST CHRG	0 KM	Displays the distance traveled since the last charge event took place.
CYC LST CHRG	XX	Displays the number of power transfer cycles that have occurred since the last time the vehicle was charged.
CHRG STOP Charging Stop Criteria	“CHARGE’ “NORMAL” “PERCENT” “COUPLER” “battery pack module (BPM) FLT” “CHARGER FLT” “MIN PWR”	Displays the reason the battery pack module (BPM) stopped charging. **CHARGE** = The vehicle is currently charging. **NORMAL** = Charging was completed based on BP current completion criteria. **PERCENT** = Charging was completed based on amp hours returned. **COUPLER** = Charge coupler was removed before charging was complete. **CHARGER FLT** = Charger reported to battery pack module (BPM) that it had a fault. **MIN PWR** = Minimum output power from the charger was reached so battery pack module (BPM) terminated charging.
EQUALIZING	“YES” OR “NO”	Displays YES when the battery pack module (BPM) began/completed equalization (leveling) charging.
BP COOLING	“YES” OR “NO”	Displays YES when the battery pack (BP) required cooling during charging.
ADD TIME–TEMP	“YES” OR “NO”	Displays YES when the charge time was increased based on the temperature of the battery pack during charging.
ADD TIME–PWR	“YES” OR “NO”	Displays YES when the charge time was increased based on the available power from the charger.
BASE CHRG	0.0 hours	Displays the time taken to complete base charging. Base charging means no equalization, aux charging, preconditioning or vehicle support.
AMP–HRS USED	0.0	Displays the amount of charge used since the last charge occurred.
AMP–HR RETUR	0.0	Displays the amount of charge returned during this charging event.
BP VOLT START	0-430 Volts	Displays the pack voltage value at the start of this charging event.

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EV SCANNER-battery pack module (BPM)		
MAX BP VOLTS	0-430 Volts	Displays the maximum pack voltage that occurred during this charging event.
BP CUR END	0-430 amps	Displays the current the battery pack was receiving when this charging event ended.
PSOC START	0-100%	Displays the pack state of charge (PSOC) at the start of this charging event. 15% pack state of charge (PSOC) = 0% user state of charge (USOC).
pack state of charge (PSOC) END	0-100%	Displays the pack state of charge (pack state of charge (PSOC)) at the end of this charging event. 15% pack state of charge (PSOC) = 0% user state of charge (USOC).
EQU COMPLETE	0%	Displays the percent of equalization completed during this charging event.
BP TEMP STRT	XX°C	Displays the temperature value when this charging event started.
MAX BP TEMP	XX°C	Displays the maximum temperature value achieved during this charging event.
CHRG MIN PWR	XX Watts	Displays the minimum output power that the charger design being used can supply.
CHRG MAX PWR	XXXX Watts	Displays the maximum output power that the charger design being used can supply.
CHRG ID	XXX	Displays the 8-digit charger software ID of the charger used during this charging event.
BAT MOD COND		
Code Number	XXX	Represents the diagnostic trouble code (DTC) number of the fault.
# of Occurrences	XX	Represents number of times the diagnostic trouble code (DTC) has occurred.
CYCLE SINCE LAST	XX	Represents number of power transfer cycles since the last time the diagnostic trouble code (DTC) occurred.
CYCLE SINCE FIRST	XX	Represents number of power transfer cycles since the first time the diagnostic trouble code (DTC) occurred.
COMP BAT REF	0-17 Volts	Displays the compensated voltage for a 6 cell battery module.
BAT MOD DLT	-12.7 to 12.8 Volts	Displays the voltage delta between the module indicated and the normalized module voltage. Normalized module voltage = battery pack voltage/26.
BP VOLT SUM	0-500 Volts	Displays the sum of the 26 module voltages as calculated by the battery pack module (BPM).
BP CURRENT	-440 to 440 amps	Displays the current flowing in the battery pack that is used for control purposes. The current is measured at the shunt in the battery pack. Positive current = charging.
BP TEMP	-18°C to 66°C (-4°F to 150.8°F)	Displays the temperature used for battery pack module (BPM) control purposes.
pack state of charge (PSOC)	0-100%	Displays the percentage of pack state of charge when the fault occurred. 15% pack state of charge (PSOC) = 0% user state of charge (USOC).

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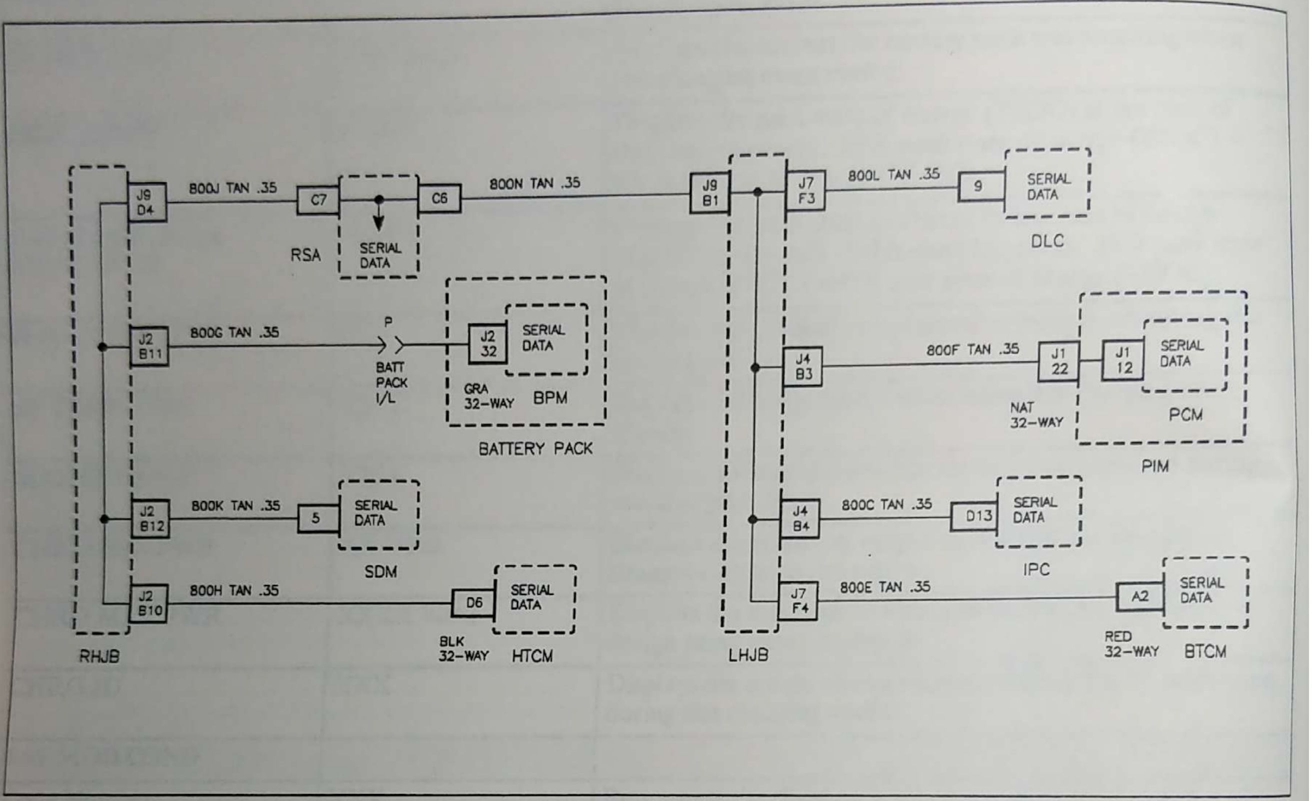
NOTES

ON–BOARD DIAGNOSTIC SYSTEM CHECK


J9
D4
800J TAN .35
C7
C6
800N TAN .35
RSA
SERIAL
DATA
J2
B11
800G TAN .35
P
BATT
PACK
I/L
J2
32
SERIAL
DATA
GRA
32–WAY
BPM
BATTERY PACK
J2
B12
800K TAN .35
5
SERIAL
DATA
SDM
J2
B10
800H TAN .35
D6
SERIAL
DATA
BLK
32–WAY
HTCM
RHJB
J9
B1
J7
F3
800L TAN .35
9
SERIAL
DATA
DLC
J4
B3
800F TAN .35
J1
22
J1
12
SERIAL
DATA
NAT
32–WAY
PCM
PIM
J4
B4
800C TAN .35
D13
SERIAL
DATA
IPC
J7
F4
800E TAN .35
A2
SERIAL
DATA
RED
32–WAY
BTCM
LHJB

PSMELC68207AA

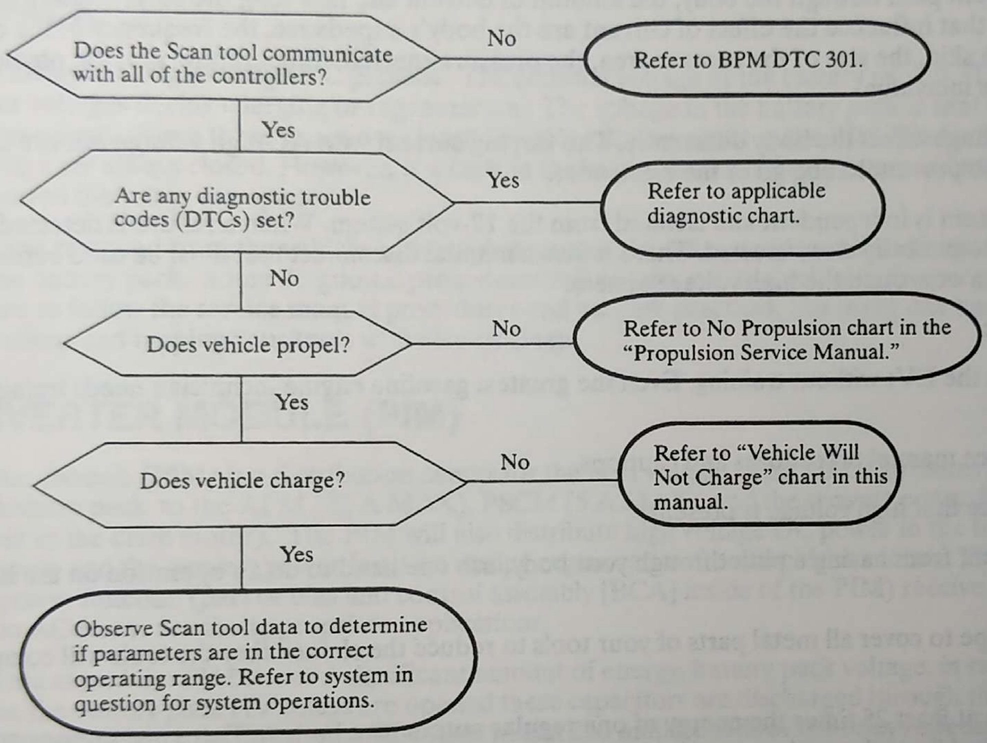
ON–BOARD DIAGNOSTIC SYSTEM CHECK

Since a Scan tools is required to perform any diagnostics, this is the starting point. The battery pack module (BPM) is the master of the universal asynchronous receiver transmitter (UART) and all of the controllers (modules) communicate over the UART bus. The BPM communicates with charger over a separate data link which is a class II data bus.

When the vehicle is powered to the RUN mode, all of the controllers are powered up and the vehicle goes through a system check. The BPM then initiates all of the communications between the other controllers. The BPM will send a polling message to each controller and each controller will respond with the requested information. The other controllers listen (eavesdrop) on the line for information they may need to perform a function.

If data can be read, the vehicle propels, and there are no diagnostic trouble codes (DTCs) stored, then diagnostics will depend on symptoms or customer complaints.

ON–BOARD DIAGNOSTIC SYSTEM CHECK


Does the Scan tool communicate with all of the controllers?
No
Refer to BPM DTC 301.
Yes
Are any diagnostic trouble codes (DTCs) set?
Yes
Refer to applicable diagnostic chart.
No
Does vehicle propel?
No
Refer to No Propulsion chart in the "Propulsion Service Manual."
Yes
Does vehicle charge?
No
Refer to "Vehicle Will Not Charge" chart in this manual.
Yes
Observe Scan tool data to determine if parameters are in the correct operating range. Refer to system in question for system operations.

HIGH VOLTAGE SAFETY

CAUTION: DC AND AC HIGH VOLTAGE. TO HELP AVOID INJURY, ALWAYS FOLLOW THE SERVICE MANUAL PROCEDURES AND MANUALLY DISCONNECT THE HIGH VOLTAGE SYSTEM BEFORE WORKING ON OR AROUND IT.

The EV1 has both high voltage DC and AC systems, as well as a 12-volt system. DC and AC high voltage are both very dangerous and can cause severe burns and shock. You first need training about how to repair the EV1 and then must follow the proper repair procedures to minimize the risk.

Currents as low as 0.5 ma AC OR 2 ma DC can cause injuries under some conditions. The potential for injury depends on the current path through the body, the amount of current and how long the current flows through the body. Other factors that influence the effect of current are the body's impedance, the frequency of the current, the moisture level of the skin, the size of the contact area, the pressure exerted, temperature, and the physiological characteristics of the individual.

AC and DC high voltage affect the body differently. The varying current with AC high voltage is more traumatic to the body and can also prevent letting go of the electrodes.

The high voltage system is independent and isolated from the 12-volt system. When a failure is detected, the high voltage system is automatically disconnected. There is also a manual disconnect that must be used before service work is performed on or around the high voltage system.

To help avoid injury:

- Do not work on the EV1 without training. Even the greatest gasoline engine technician needs training for this vehicle.
- Follow the service manual procedures and cautions.
- ALWAYS assume that high voltage is present.
- To prevent current from having a path through your body, use one hand to do an operation on the high voltage system.
- Use electrical tape to cover all metal parts of your tools to reduce the chance that the tools will complete a current path.

The battery pack has at least 25 times the energy of one regular automotive battery. Extra precautions are when the battery pack is removed from the car because the automatic and manual disconnect cannot protect you from a disconnected battery pack. Follow the service manual procedures and cautions.

HIGH VOLTAGE SYSTEM

The high voltage system consists of the battery pack, power inverter module, accessory AC and DC power control module (APM) and systems, power steering control module (PSCM) and systems, drive motor and charge receptacle.

All of the HV components are interlocked. The interlock is a low voltage circuit that runs next to all of the high voltage circuits as the high voltage goes from one system to another. If an open or ground occurs in the high voltage circuit (e.g., disconnecting a HV connector with relays closed) the interlock will detect this open and shut the high voltage down by opening the relays.

BATTERY PACK

The battery pack always has high voltage DC present. The nominal voltage of the battery pack is 312 volts and approaches higher voltages during charging or regeneration. The voltage in the battery pack is sent to the vehicle (PIM) by two large relays. When these relays are closed the 312 volts is present at the PIM. Under normal operating conditions the relays are always closed. However, if a fault in the high voltage system is detected or the manual disconnect is removed the relays are opened.

If the battery pack is removed from the vehicle additional steps must be taken to reduce the voltage to a safe level for working on the battery pack. Some diagnostic procedures will require you to work with the pack at 312 volts and care must be taken to follow the service manual procedures and use safe practices, like using one hand when performing operations and tapping your tools with electrical tape.

POWER INVERTER MODULE (PIM)

The power inverter module (PIM) is a distribution center for the high voltage. The PIM distributes high voltage DC power from the battery pack to the APM (22 A MAX), PSCM (5 A MAX), and the convert power function (propulsion power to the drive motor). The PIM will also distribute high voltage DC power to the battery pack from the charge receptacle and the convert power function during regeneration from the drive motor. The APM, PSCM, and the convert power function (part of bias and control assembly [BCA] inside of the PIM) receive DC power and convert the DC to AC power for the appropriate applications.

When the relays are closed the PIM stores a significant amount of energy, battery pack voltage, in two large capacitors. When the battery pack HV relays are opened these capacitors are discharged through the bus discharge assembly. The bus voltage must be reduced to 42.4 volts within 250 milliseconds of the relays opening. If a failure occurs in the bus discharge assembly that prevents the bus from discharging high voltage will be present even though the relays are open. If this condition occurs follow the steps in high voltage present with relays open chart in this section of the service manual.

ACCESSORY AC AND DC POWER CONTROL MODULE (APM)

The APM receives its high voltage from the PIM. The APM uses this voltage to provide power to three main functions:

1. Convert DC to AC for compressor control
2. Power a DC power supply for auxiliary battery charging
3. Provide DC power for the heated windshield

The compressor motor is three phase AC.

A high voltage cable runs from the APM to the compressor motor. If this connector is disconnected the compressor control function will be shut down. The cable also contains a ground shield to provide a ground path in the event that a compressor motor has shorted. There is an additional ground strap from the case of the motor to chassis ground for the same purpose. The compressor motor is a high voltage component and is isolated from chassis ground. The ground paths prevent the components from having a high voltage potential to chassis ground. The compressor has a low voltage sense lead to detect the presence of voltage potential on the motor case. If a voltage potential appears on the compressor motor the HTCM will set a DTC and disable the compressor operation.

POWER STEERING CONTROL MODULE (PSCM)

The PSCM receives its high voltage from the PIM. The PSCM uses this voltage to provide power to the power steering pump for operation. The power steering pump motor is three phase AC. A high voltage cable runs from the PSCM to the power steering pump motor. If this connector is disconnected the power steering control function will be shut down. The cable also contains a ground shield to provide a ground path in the event that a power steering motor has shorted. There is an additional ground strap from the case of the motor to chassis ground for the same purpose. The power steering motor is a high voltage component and is isolated from chassis ground. The ground paths prevent the components from having a high voltage potential to chassis ground. The PSCM like the compressor has a low voltage sense lead. If a voltage potential appears on the power steering pump, the HTCM will detect this, set a DTC, and turns on the SERVICE SOON telltale. If the ground is lost the power steering motor pump will open the interlock circuit disabling any power transfer.

DRIVE MOTOR

The drive motor receives its high voltage from the convert power function inside of the PIM. Enabling this function allows the high voltage DC to be converted into high voltage AC for drive motor power. The drive motor is three phase AC. The drive motor HV is passed through a blind mate connector. There is no cable between the PIM and drive motor. It is a pin to pin contact (blind mate connector). However the drive motor does contain a case ground strap to chassis ground. The drive motor is a high voltage component and is isolated from chassis ground. The ground path prevent the components from having a high voltage potential to chassis ground.

The convert power function is also used to enable regeneration. During braking or coast down the drive motor AC power recovered is converted to DC and passed from the PIM to the battery pack for charging the batteries.

CHARGE RECEPTACLE

The charge receptacle receives its high voltage from a charger. The input power is AC from a wall 110V or 220V outlet. The charge receptacle converts this AC power to DC power. This DC power is passed through the PIM HV bus to the battery pack for charging the battery modules. Any open or shorting of the charge receptacle will be sensed by the auto disconnect system and the drive motor battery pack module (BPM) will shut off the charging function.

AUTO DISCONNECT (AD) SYSTEM

The AD systems opens and closes the HV relays. This system will detect and open the relays under the following conditions:

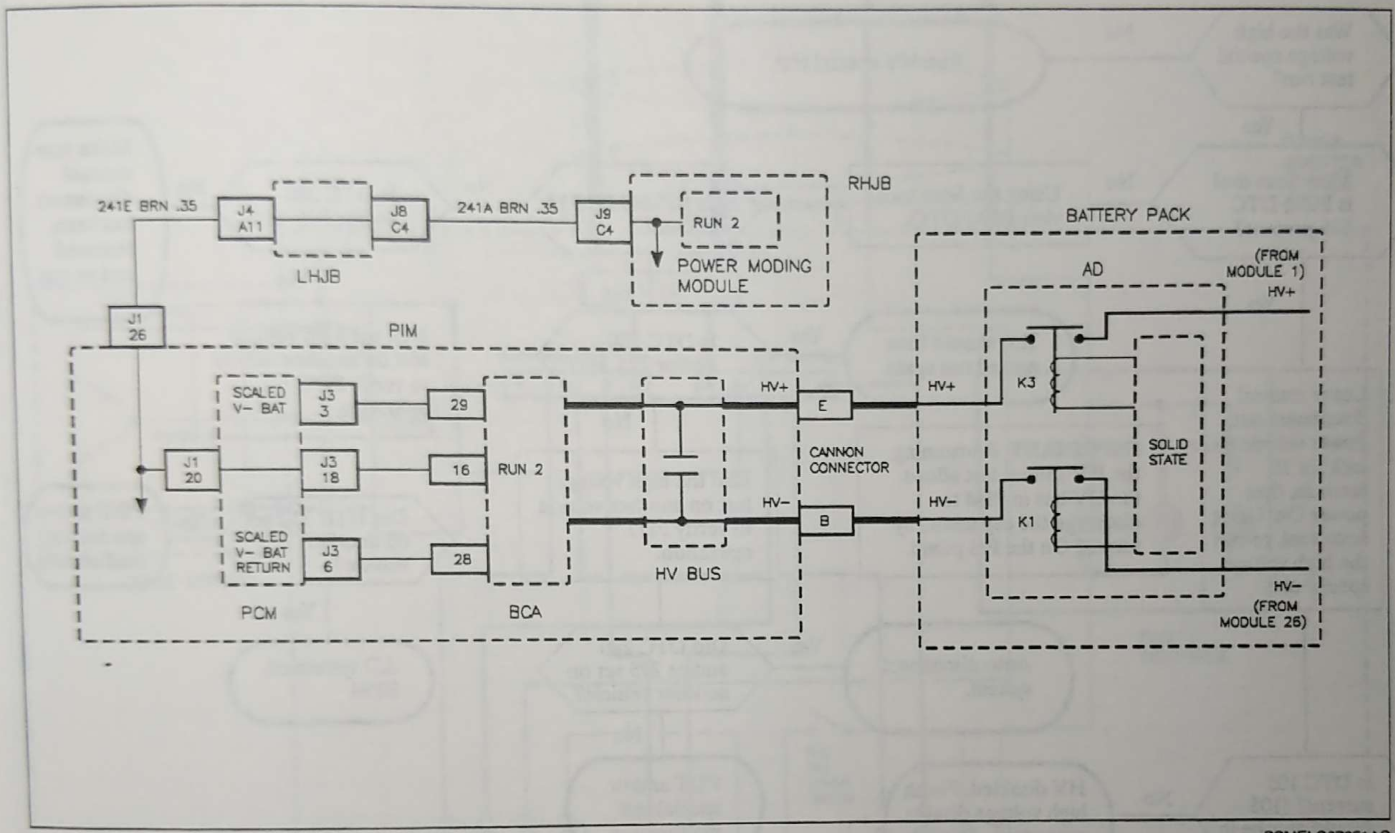
- Precharge failure: Attempt to close HV relays failed
- DC and some AC isolation failures: Resistance measured from HV + and – bus to chassis ground.
- Interlock Loop: Low voltage circuit detect
- Chassis ground: Loss of chassis ground reference for isolation detection
- Ground Sense: Redundant chassis ground reference
- Under voltage fault: AD not receiving required HV from batteries
- BPM command: BPM commanded relays open

Detailed information on these functions can be found in the AD system section of this service manual.

MANUAL DISCONNECT

The manual disconnect is located behind the drivers seat. When the manual disconnect knob is turned the interlock loop opens. The AD system will detect this and open the relays. The knob can then be pulled out which will open the series string of the batteries between battery modules 13 and 14. If the relays are not opened due to a failure removing the manual disconnect will reduce the HV potential at the HV harness connector to the PIM. If this occurs refer to the service manual high voltage present chart.

FAILED PORTABLE DIAGNOSTIC TOOL, HIGH VOLTAGE SPECIAL TEST OR HIGH VOLTAGE PRESENT WITH RELAYS COMMANDED OPEN


241E BRN .35
J4
A11
J8
C4
LHJB
241A BRN .35
J9
C4
RHJB
RUN 2
POWER MODING
MODULE
BATTERY PACK
AD
(FROM
MODULE 1)
HV+
J1
26
PIM
SCALED
V− BAT
J3
3
29
J1
20
J3
18
16
RUN 2
SCALED
V− BAT
RETURN
J3
6
28
PCM
BCA
HV BUS
HV+
HV−
E
B
CANNON
CONNECTOR
HV+
HV−
K3
K1
SOLID
STATE
HV−
(FROM
MODULE 26)

PSMELC67651AC

FAILED PORTABLE DIAGNOSTIC TOOL, HIGH VOLTAGE SPECIAL TEST OR HIGH VOLTAGE PRESENT WITH RELAYS COMMANDED OPEN

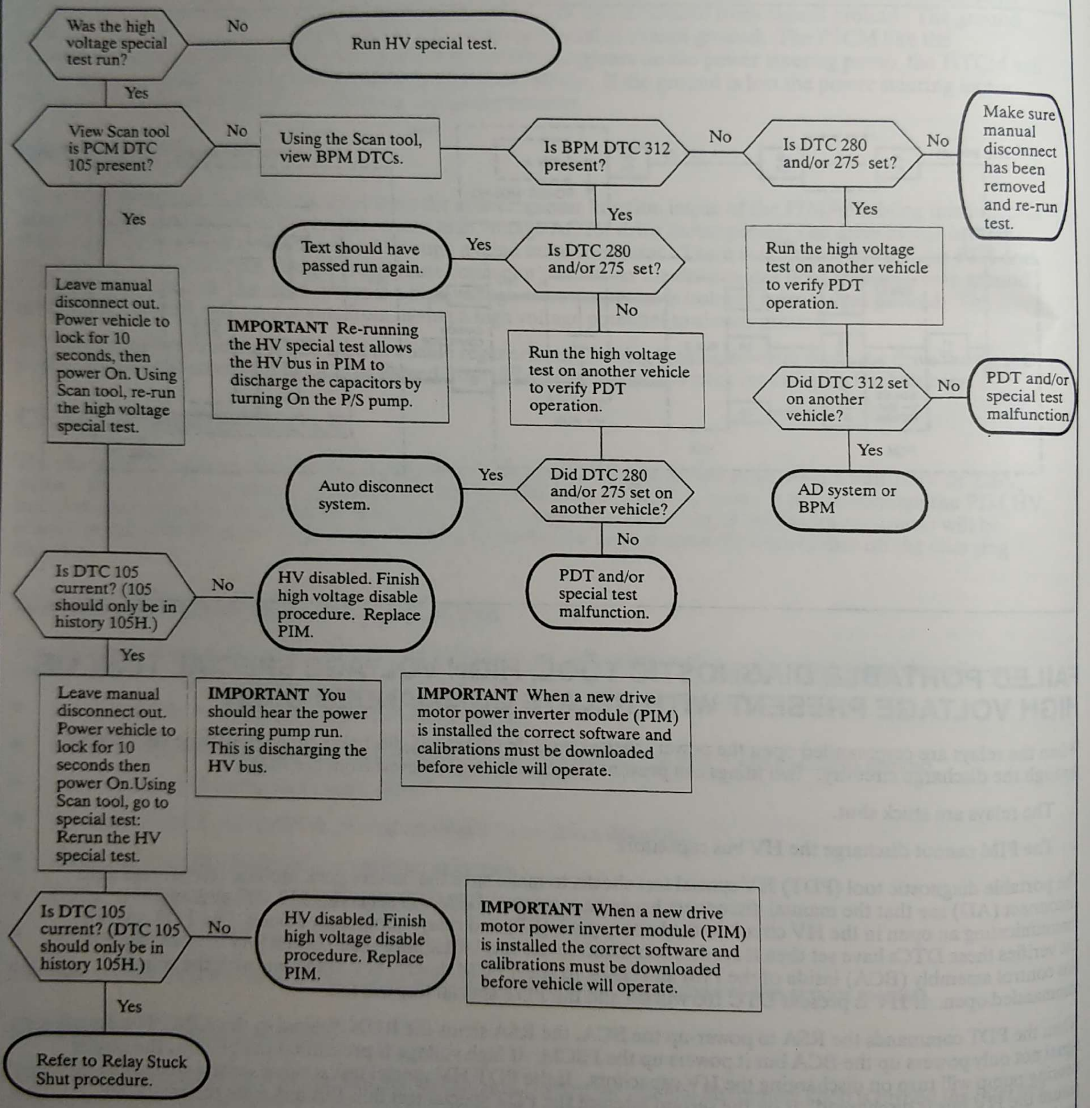
When the relays are commanded open the power inverter module (PIM) will discharge the high voltage (HV) bus through the discharge circuitry. Two things can prevent HV from being removed from the PIM.

1. The relays are stuck shut.
2. The PIM cannot discharge the HV bus capacitors.

The portable diagnostic tool (PDT) HV special test checks to make sure the battery pack module (BPM) and auto disconnect (AD) see that the manual disconnect has been removed. BPM will set codes 312, 280 and/or 275 communicating an open in the HV circuit in the battery pack (BP) and relays commanded open. The PDT special test verifies these DTCs have set then it sends a command to the run/lock shifter assembly (RSA) to power up the bias control assembly (BCA) inside of the PIM and check to see if PCM detects HV at the bus with the relays commanded open. If HV is present DTC 105 will set and the PDT special test will fail.

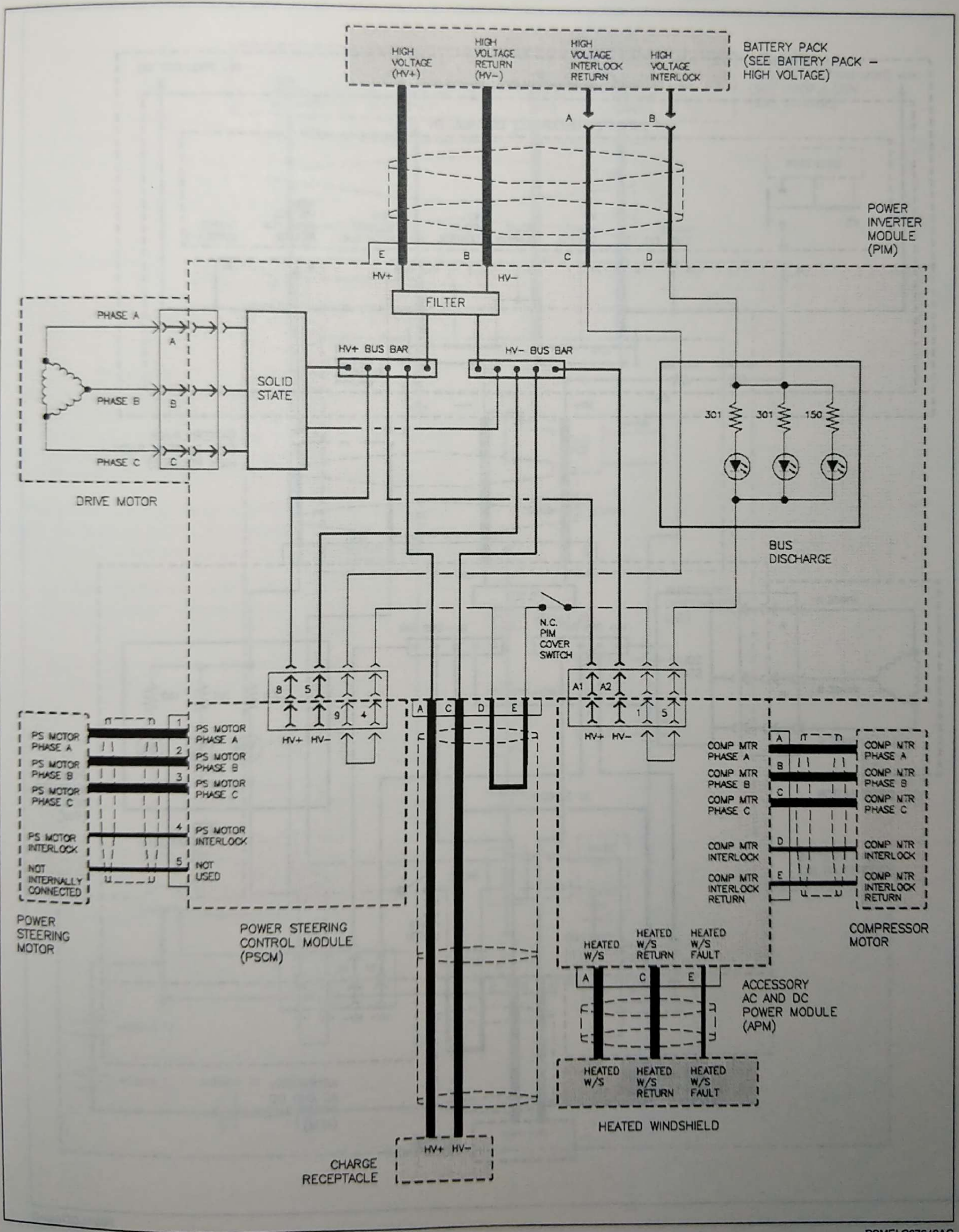
When the PDT commands the RSA to power-up the BCA, the RSA sends the RUN 2 signal to the PIM. The Run 2 signal not only powers up the BCA but it powers up the PSCM. If high voltage is present on the HV bus the power steering pump will turn on discharging the HV capacitors. If the PDT HV special test is run a second time this will ensure the HV bus is discharged. If on the second attempt the PDT special test fails this indicates the relays are stuck shut.

FAILED PORTABLE DIAGNOSTIC TOOL, HIGH VOLTAGE SPECIAL TEST OR HIGH VOLTAGE PRESENT WITH RELAYS COMMANDED OPEN


Was the high voltage special test run?
No
Run HV special test.
Yes
View Scan tool is PCM DTC 105 present?
No
Using the Scan tool, view BPM DTCs.
Is BPM DTC 312 present?
No
Is DTC 280 and/or 275 set?
No
Make sure manual disconnect has been removed and re-run test.
Yes
Yes
Yes
Text should have passed run again.
Yes
Is DTC 280 and/or 275 set?
Run the high voltage test on another vehicle to verify PDT operation.
Leave manual disconnect out. Power vehicle to lock for 10 seconds, then power On. Using Scan tool, re-run the high voltage special test.
IMPORTANT Re-running the HV special test allows the HV bus in PIM to discharge the capacitors by turning On the P/S pump.
No
Run the high voltage test on another vehicle to verify PDT operation.
Did DTC 312 set on another vehicle?
No
PDT and/or special test malfunction
Yes
Auto disconnect system.
Yes
Did DTC 280 and/or 275 set on another vehicle?
AD system or BPM
No
Is DTC 105 current? (105 should only be in history 105H.)
No
HV disabled. Finish high voltage disable procedure. Replace PIM.
PDT and/or special test malfunction.
Yes
Leave manual disconnect out. Power vehicle to lock for 10 seconds then power On. Using Scan tool, go to special test: Rerun the HV special test.
IMPORTANT You should hear the power steering pump run. This is discharging the HV bus.
IMPORTANT When a new drive motor power inverter module (PIM) is installed the correct software and calibrations must be downloaded before vehicle will operate.
Is DTC 105 current? (DTC 105 should only be in history 105H.)
No
HV disabled. Finish high voltage disable procedure. Replace PIM.
IMPORTANT When a new drive motor power inverter module (PIM) is installed the correct software and calibrations must be downloaded before vehicle will operate.
Yes
Refer to Relay Stuck Shut procedure.

CS CamScanner

PROPULSION (HIGH VOLTAGE)


HIGH VOLTAGE (HV+)
HIGH VOLTAGE RETURN (HV−)
HIGH VOLTAGE INTERLOCK RETURN
HIGH VOLTAGE INTERLOCK
BATTERY PACK (SEE BATTERY PACK – HIGH VOLTAGE)
A
B
POWER INVERTER MODULE (PIM)
E
B
C
D
HV+
HV−
FILTER
HV+ BUS BAR
HV− BUS BAR
PHASE A
PHASE B
PHASE C
A
B
C
SOLID STATE
DRIVE MOTOR
301
301
150
BUS DISCHARGE
N.C. PIM COVER SWITCH
8
5
9
4
HV+
HV−
A1
A2
1
5
HV+
HV−
A
C
D
E
PS MOTOR PHASE A
PS MOTOR PHASE B
PS MOTOR PHASE C
PS MOTOR INTERLOCK
NOT INTERNALLY CONNECTED
1
2
3
4
5
PS MOTOR PHASE A
PS MOTOR PHASE B
PS MOTOR PHASE C
PS MOTOR INTERLOCK
NOT USED
POWER STEERING MOTOR
POWER STEERING CONTROL MODULE (PSCM)
COMP MTR PHASE A
COMP MTR PHASE B
COMP MTR PHASE C
COMP MTR INTERLOCK
COMP MTR INTERLOCK RETURN
A
B
C
D
E
COMP MTR PHASE A
COMP MTR PHASE B
COMP MTR PHASE C
COMP MTR INTERLOCK
COMP MTR INTERLOCK RETURN
COMPRESSOR MOTOR
HEATED W/S
HEATED W/S RETURN
HEATED W/S FAULT
A
C
E
ACCESSORY AC AND DC POWER MODULE (APM)
HEATED W/S
HEATED W/S RETURN
HEATED W/S FAULT
HEATED WINDSHIELD
HV+
HV−
CHARGE RECEPTACLE

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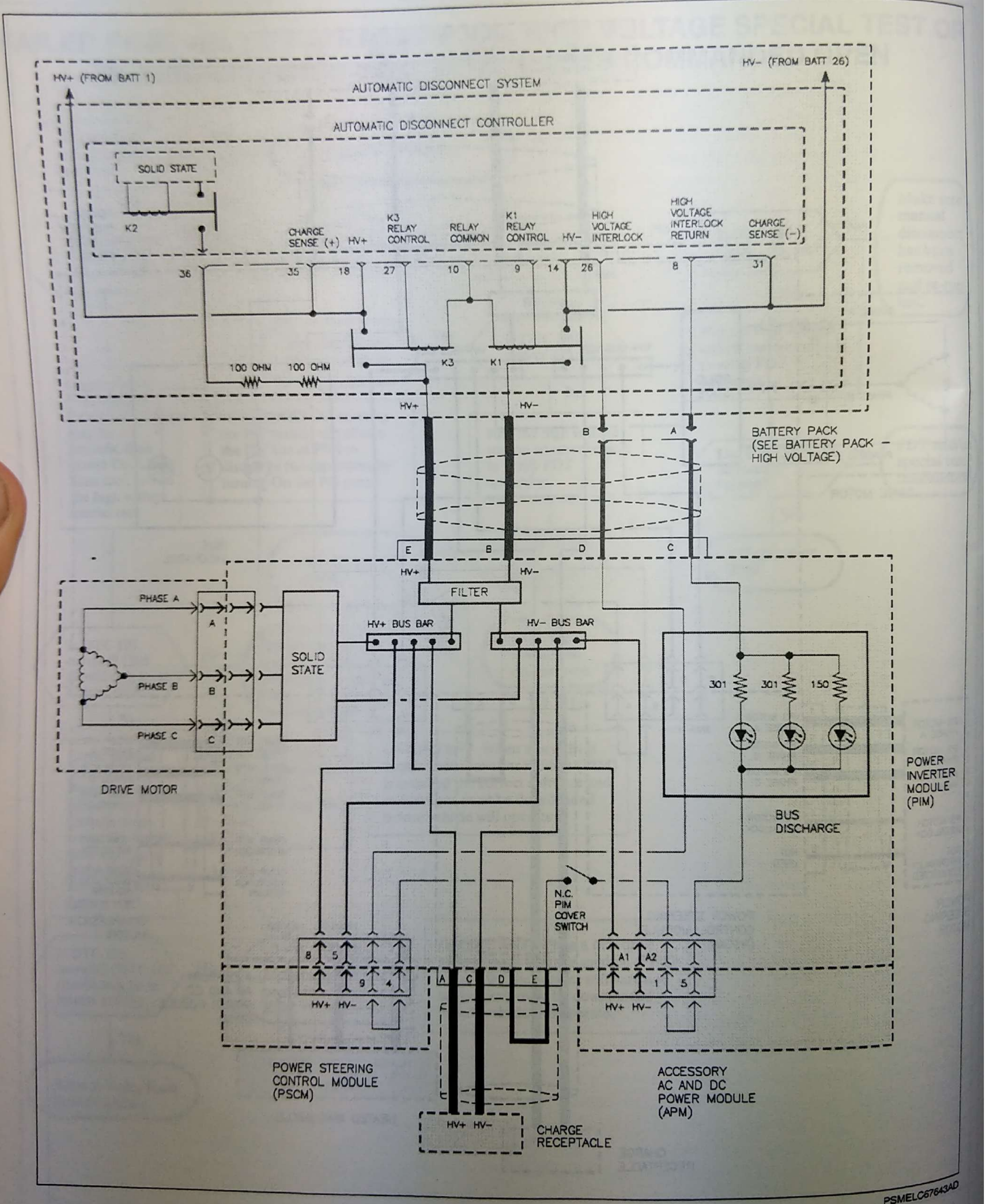
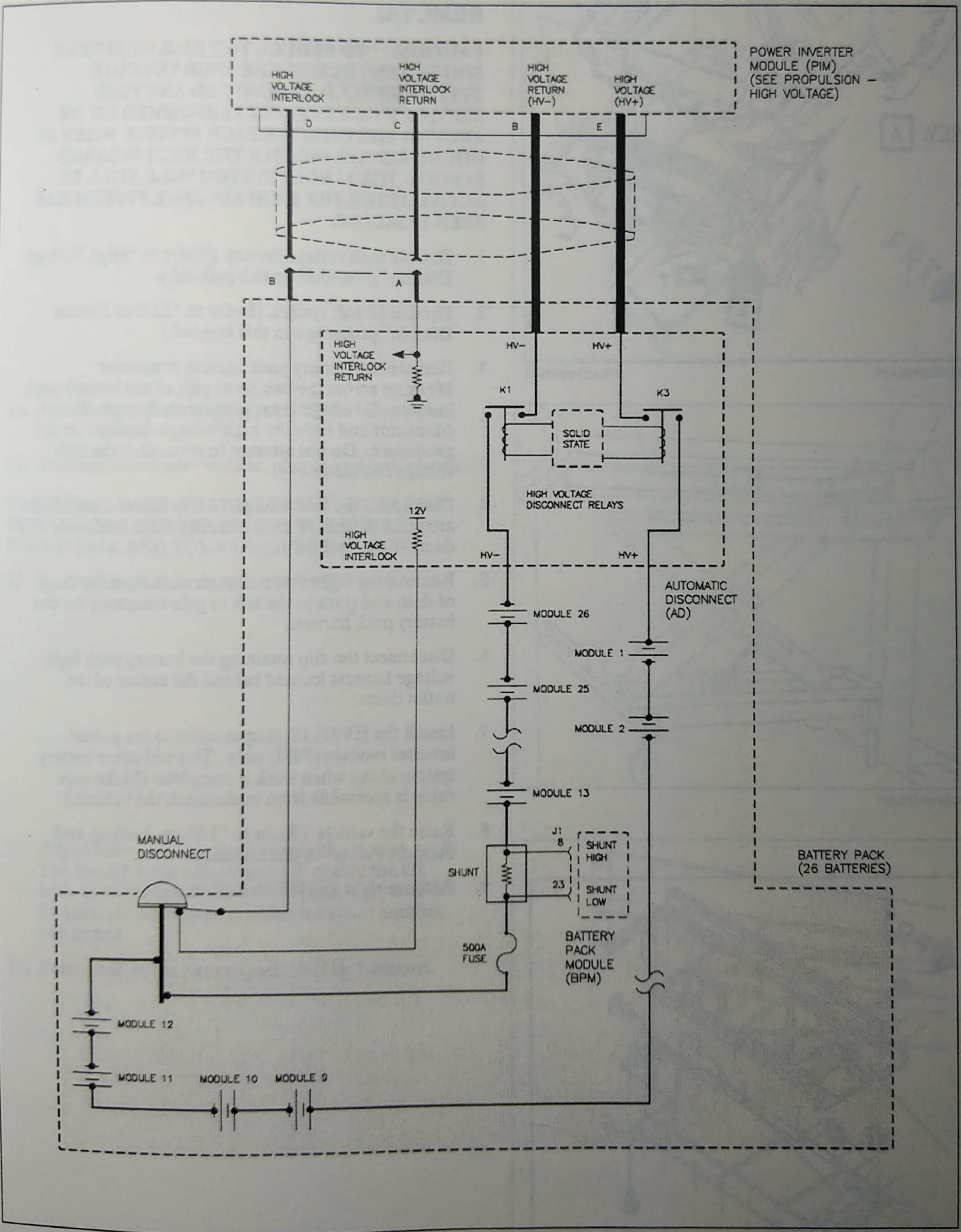
PROPULSION (HIGH VOLTAGE—CONT.)


HV+ (FROM BATT 1)
HV– (FROM BATT 26)
AUTOMATIC DISCONNECT SYSTEM
AUTOMATIC DISCONNECT CONTROLLER
SOLID STATE
K2
CHARGE SENSE (+)
HV+
K3 RELAY CONTROL
RELAY COMMON
K1 RELAY CONTROL
HV–
HIGH VOLTAGE INTERLOCK
HIGH VOLTAGE INTERLOCK RETURN
CHARGE SENSE (–)
36
35
18
27
10
9
14
26
8
31
K3
K1
100 OHM
100 OHM
HV+
HV–
B
A
BATTERY PACK (SEE BATTERY PACK – HIGH VOLTAGE)
E
B
D
C
HV+
HV–
FILTER
HV+ BUS BAR
HV– BUS BAR
PHASE A
PHASE B
PHASE C
A
B
C
SOLID STATE
DRIVE MOTOR
301
301
150
BUS DISCHARGE
POWER INVERTER MODULE (PIM)
N.C. PIM COVER SWITCH
8
5
9
4
HV+ HV–
A
C
D
E
A1
A2
1
5
HV+ HV–
POWER STEERING CONTROL MODULE (PSCM)
HV+ HV–
CHARGE RECEPTACLE
ACCESSORY AC AND DC POWER MODULE (APM)

PSMELC67643AD

BATTERY PACK (HIGH VOLTAGE)


HIGH VOLTAGE INTERLOCK
HIGH VOLTAGE INTERLOCK RETURN
HIGH VOLTAGE RETURN (HV−)
HIGH VOLTAGE (HV+)
POWER INVERTER MODULE (PIM) (SEE PROPULSION – HIGH VOLTAGE)
D
C
B
E
B
A
HIGH VOLTAGE INTERLOCK RETURN
HV−
HV+
K1
K3
SOLID STATE
HIGH VOLTAGE DISCONNECT RELAYS
12V
HIGH VOLTAGE INTERLOCK
HV−
HV+
AUTOMATIC DISCONNECT (AD)
MODULE 26
MODULE 1
MODULE 25
MODULE 2
MODULE 13
J1
8
23
SHUNT HIGH
SHUNT LOW
SHUNT
500A FUSE
BATTERY PACK MODULE (BPM)
MANUAL DISCONNECT
BATTERY PACK (26 BATTERIES)
MODULE 12
MODULE 11
MODULE 10
MODULE 9

PSMELC68116AA

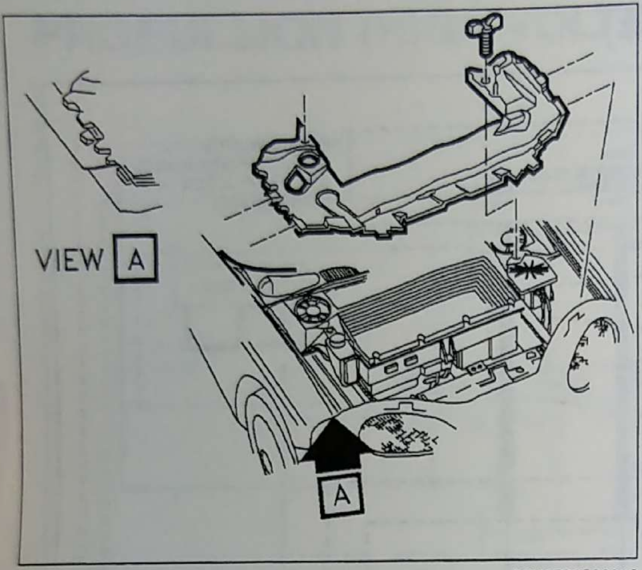
CS CamScanner

BATTERY PACK

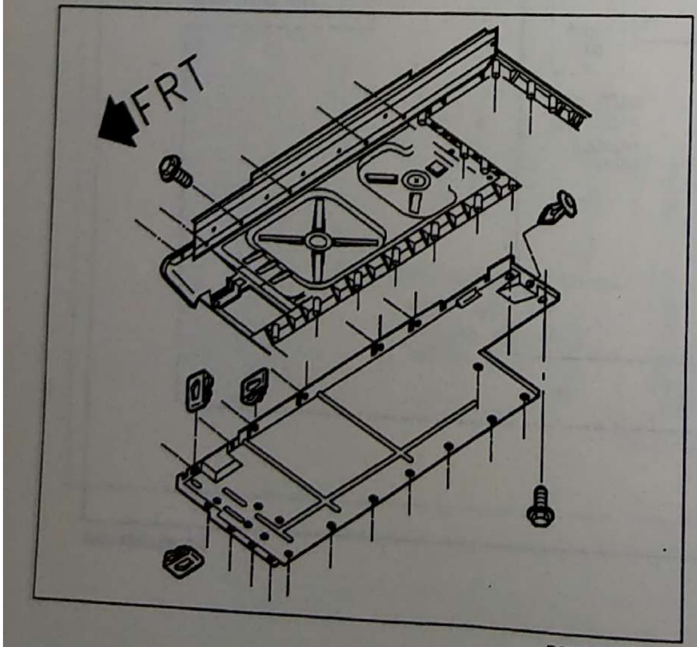
REMOVAL

CAUTION: TO REDUCE THE RISK OF SEVERE SHOCKS AND BURNS, THE HIGH VOLTAGE SYSTEM SHOULD BE DISABLED ANY TIME SERVICE WORK IS BEING PERFORMED ON OR AROUND THE HIGH VOLTAGE SYSTEM. WHEN IN DOUBT, ALWAYS DISABLE THE HIGH VOLTAGE SYSTEM. THE 12 VOLT SYSTEM WILL STILL BE ACTIVE AFTER THE HIGH VOLTAGE SYSTEM HAS BEEN DISABLED.

1. Disable high voltage system. (Refer to "High Voltage Disable" procedure in this manual.)
2. Disable 12 volt system. (Refer to "12 Volt System Disable" procedure in this manual.)
3. Remove the battery pack cannon connector. Measure across the two large pins of the battery pack harness. If voltage is present carefully tape off connector and redo the high voltage disable procedure. Do not attempt to reconnect the high voltage connector.
4. Disconnect the low voltage 14-way barrel connector attached to front of dash near right side outlet air duct.
5. Remove the right side outlet air duct from the front of dash and push to the left to gain clearance for the battery pack harness.
6. Disconnect the clip retaining the battery pack high voltage harness located behind the center of the outlet ducts.
7. Install the EV9714Z jumper cable to the power inverter module (PIM) only. This will allow battery system check when work is complete. (Make sure cable is accessible from underneath the vehicle.)
8. Raise the vehicle. (Refer to "Lifting, Jacking, and Support Points" in this manual.)
9. Remove right and left air deflectors.

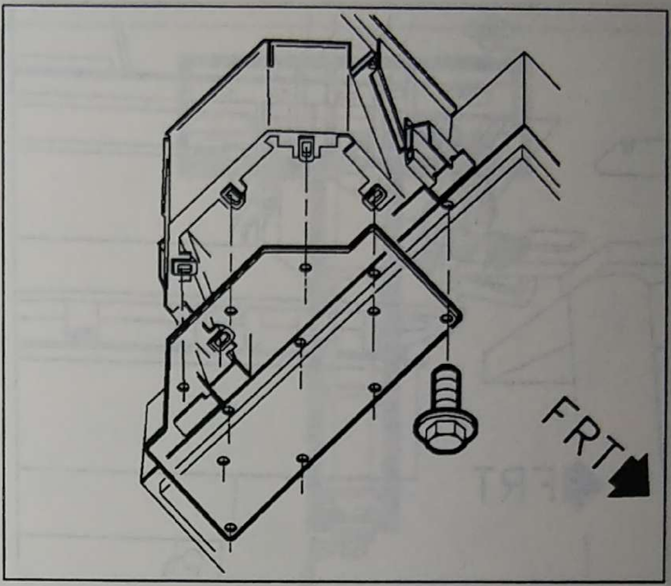


PSMGEP65869AC



PSMGEP65709AA

10. Remove underbody center rear air deflector.

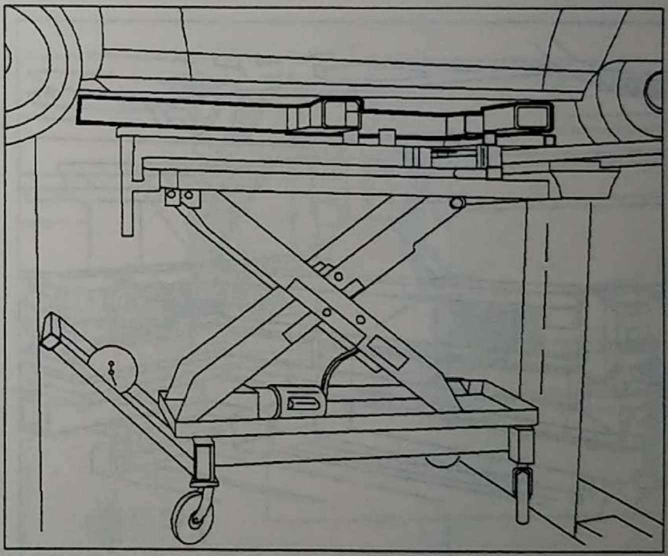


PSMGEP65703AA

11. Place battery pack tray support "T" on battery pack lift table.
12. Position table under vehicle, plug in and lock wheels.

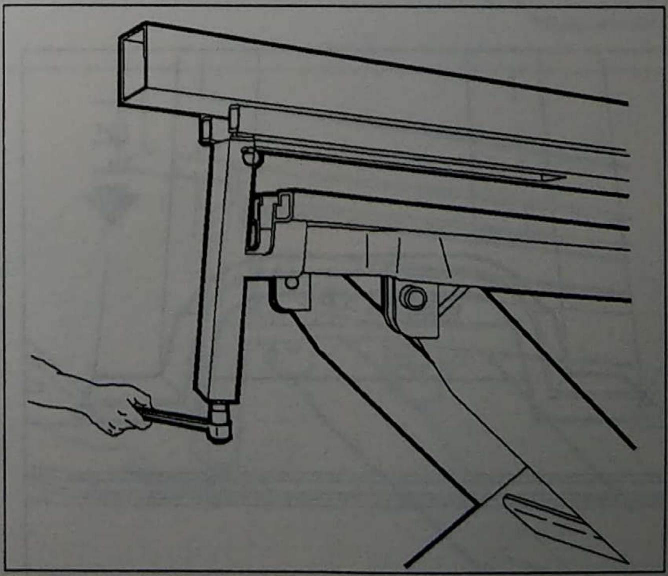
CAUTION: WHEN RAISING TABLE NEVER LIFT THE VEHICLE OFF THE HOIST. THE VEHICLE COULD FALL AND YOU COULD BE INJURED.

13. Raise table until its close to the battery pack.

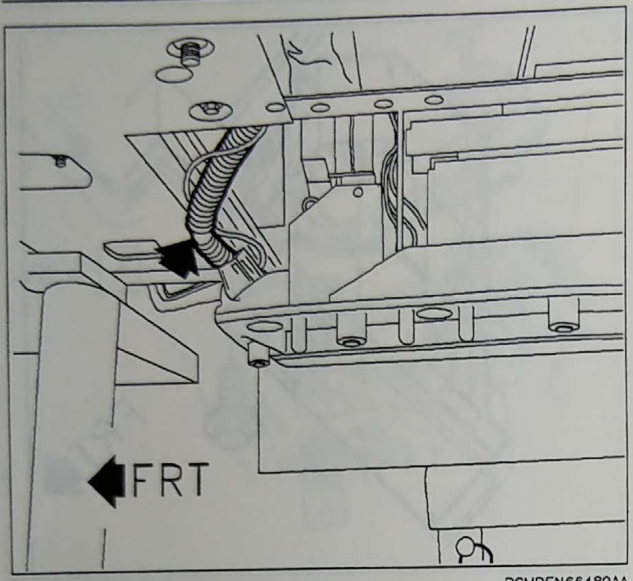


PSMPEN66487AA

14. Adjust table until it is flush against the battery pack. The fore/aft table adjustment will enable the lift table to fit flush with the battery pack. Continue to lift until the suspension is unloaded about another two inches.
15. Remove all of the battery pack-to-body fasteners.



PSMPEN66491AA



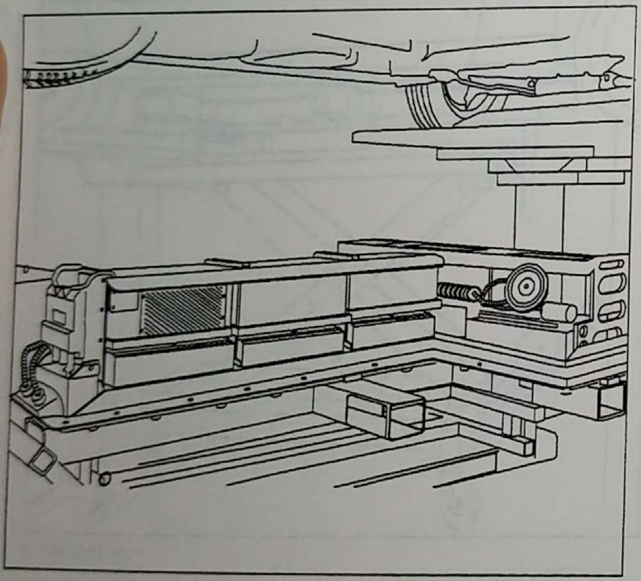
PSMPEN66489AA

16. Lower table about eight inches and pull the high voltage, 14-way and vent harness (strapped to the high voltage harness) down. Reach hand up behind axle shaft and pull the high voltage, 14-way, and vent harness down as far as they will go. Make sure harnesses have slack.

NOTICE: Do not get pinched or cut when lowering the battery pack.

17. Continue to lower lift table downward making sure the battery pack harnessess do not get caught or are not contacting any surfaces while the lift table is being lowered.

NOTICE: Make sure high voltage, low voltage harness and vent tube.

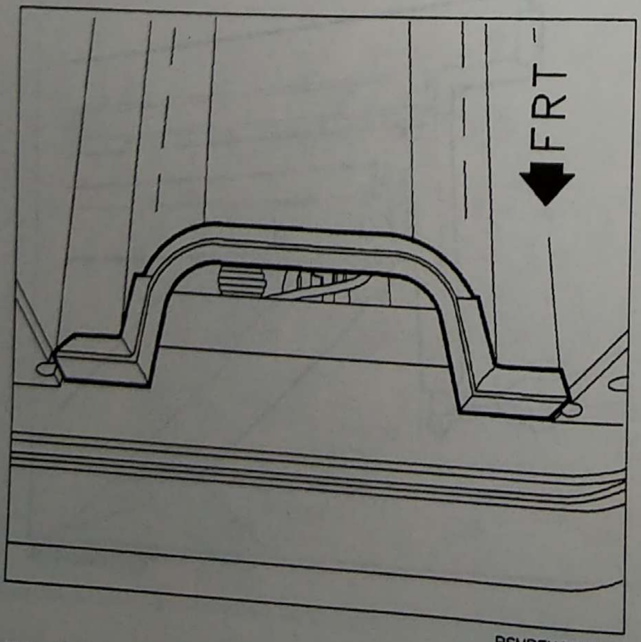


PSMPEN66486AA

18. Lower battery pack.

INSTALLATION

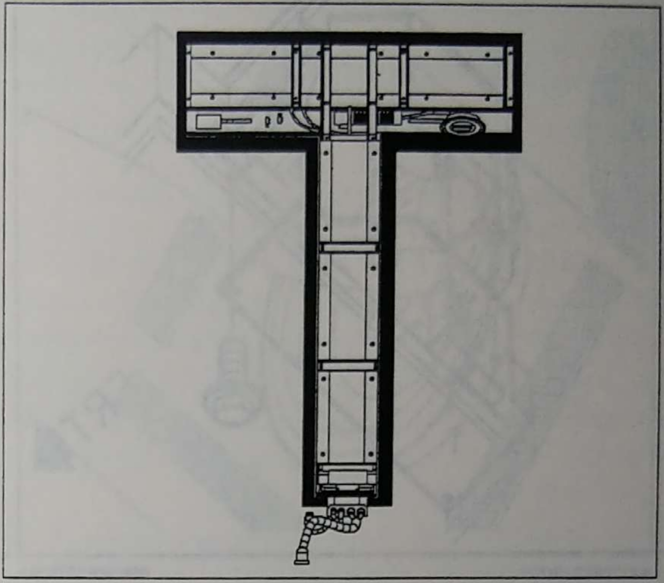
1. Install battery pack on lift.
2. Position battery pack under vehicle as far back as possible to allow clearance of the high voltage cables, wiring and vent harness.



PSMPEN66492AA

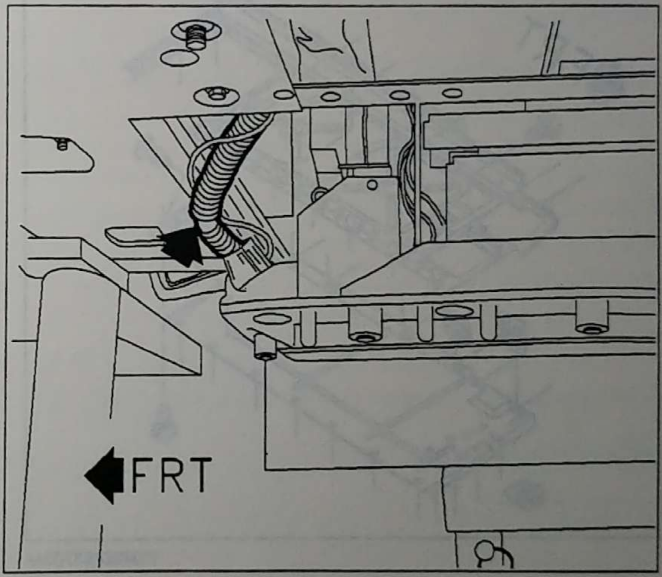
3. Inspect the front tunnel seal on the battery pack tunnel. Replace the seal it is torn or damaged.

4. Inspect battery pack tray to vehicle structure seal. Make sure it is clean from debris and there are no tears. Replace seal if damaged. Seal is highlighted in the back.



PSMELC68356AA

5. Slowly raise the battery pack making sure it is correctly lined up with the tunnel. Raise battery pack until it is just piloted into the vehicle tunnel.
6. Feed the high voltage cable, low voltage harness and vent tube behind the cradle through the vehicle opening behind the outlet duct.
7. Continue to raise the table monitoring the two back corners and the wiring and vent tube harness until the battery pack is aligned with the bottom of the vehicle tunnel.
8. Slowly install the battery pack into the tunnel. Shake the battery pack as it goes up to insure it going up freely. Be sure alignment pins on right front and left rear of pack index with structure.
9. Check that all bolt holes are lined up. If they are not lined up slightly lower battery pack and adjust into position.



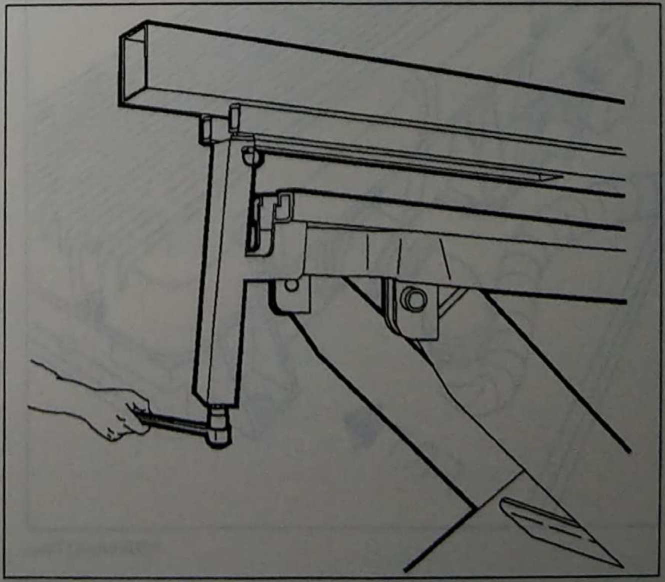
PSMPEN66489AA

10. Adjust table until battery pack is flat against vehicle structure using the fore/aft adjustment on the table.

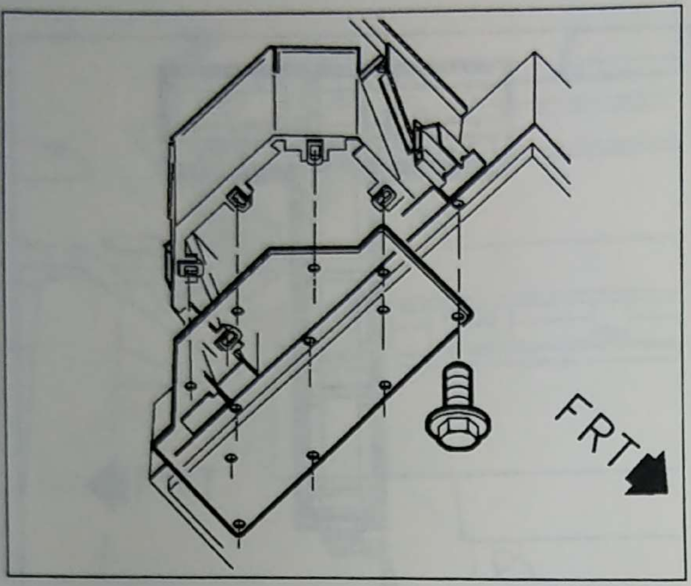
NOTICE: Do not force battery pack bolts. The structure nuts strip easily and replacement is very timely. Inspect fasteners, if they are damaged replace with new fasteners.

11. Install all battery pack to vehicle fasteners.

Torque: **29 N•m (21 ft-lbs)**

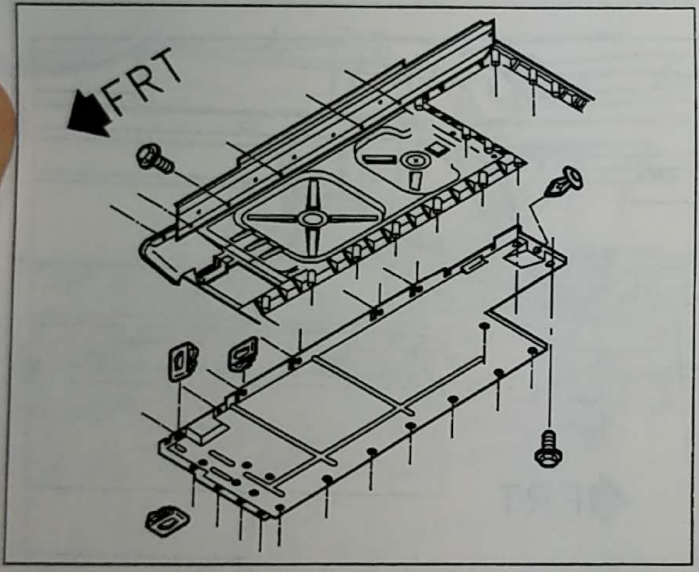


PSMPEN66491AA



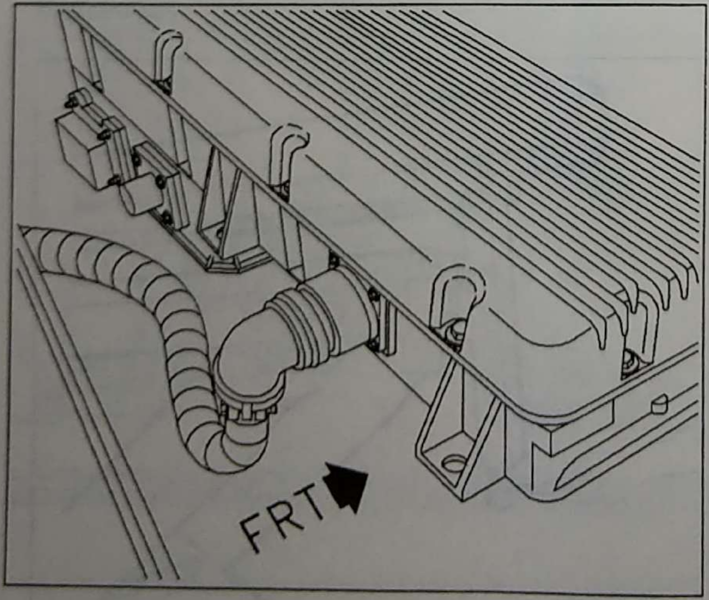
PSMGEP65703AA

12. Install underbody center rear air deflector.



PSMGEP65709AA

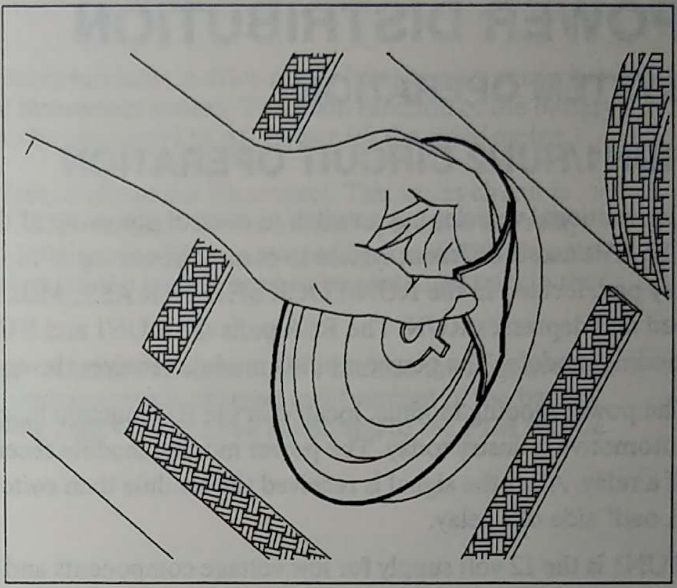
13. Install right and left air deflectors.
14. Remove battery lift table from underneath the vehicle.
15. Lower vehicle.
16. Route high voltage harness behind the outlet duct and install high voltage harness only in clip.
17. Connect the 14-way barrel connector and fasten in harness clip next to the auxiliary battery.



PSMPEN66279AA

18. Connect the cannon connector to PEB.
19. Install the right side outlet duct to front of dash.

20. Pull inner lip of manual disconnect to structure seal through to the interior.
21. Enable 12 volts system. (Refer to "12 Volt System Enable/Disable" procedure in this manual.)
22. Enable high voltage system. (Refer to "High Voltage Enable" procedure in this manual.)



PSMELC68376AA

REMOVING BATTERY PACK FROM THE LIFT TABLE

1. Carefully move the battery pack from underneath the vehicle.
2. Position the battery pack to gain access to the lift points with the fork lift.
3. Lock the wheels on the battery pack lift table.
4. Position lift truck arms all the way forward on the "T." If required to gain maximum forward position, you may have to move battery pack slightly back on table and then move fork lift arms forward.
5. Lift battery pack and "T" off lift table. Slowly back up until the lift table has been cleared and immediately lower battery pack to just a couple of inches off the floor.
6. Set the battery pack in a safe location where it cannot be accessed by any inexperienced personnel.

INSTALL BATTERY PACK ON TABLE

1. Position table to enable battery pack loading.
2. Install battery pack on fork lift truck. Make sure the lift truck arms are fully inserted into "T" before lifting the "T." If battery pack needs to be transferred to the battery lift table keep it low to the ground for transportation.
3. Lift the battery pack onto the battery table and align it with the marks on the table. Lower the battery pack onto the lift table and remove fork lift.

POWER DISTRIBUTION

SYSTEM OPERATION

RUN1/RUN2 CIRCUIT OPERATION

Conventional vehicles use a switch to control power-up of the electrical system, commonly known as an ignition switch. The EV1 uses a different system to control power-up of the electrical system. The control used by the EV1 is known as the key pad, located in the RUN/LOCK SHIFTER ASSEMBLY (RSA). The operator enters a valid key code into the key pad and depresses RUN. The RSA pulls the RUN1 and RUN2 command lines "low," sending a command to the power moding module. The power moding module receives the command and powers-up the vehicles electrical system.

The power moding module, located in the RH junction block operates very similar to a relay, a device well known in the automotive industry today. The power moding module receives a "low" signal from the RSA similar to the "Control" side of a relay. After the signal is received the module then switches and supplies RUN1 and RUN2 voltage similar to the "Load" side of a relay.

RUN1 is the 12 volt supply for low voltage components and RUN2 is the 12 volt supply that controls the high voltage components. During power-up if there is a high voltage system problem, the battery pack control module (BPM) will identify the subsystem and set a diagnostic trouble code (DTC) along with sending a serial data message to the RSA disabling RUN 2. If a high voltage system problem is identified by the BPM during a drive cycle, RUN 2 will be disabled after the vehicle is below 1 km/h.

VEHICLE "WAKE-UP COMMAND" AND "RUN 1/WAKE-UP" DURING CHARGING

When the charged coupler is inserted into the charge receptacle, the charge receptacle sends a wake-up command on the WAKE-UP COMMAND line to the battery pack module (BPM) for 1.25 seconds. After the command is received, the BPM then wakes-up for 3.0 seconds and sends out its own command on the same WAKE-UP line to the heat pump thermal control module (HTCM). The HTCM wakes-up and continues to hold the WAKE-UP COMMAND line is an input to the power moding module (located in the RH junction block).

When the power moding module sees the WAKE-UP line "High," this supplies power to cooling system components allowing the cooling system to function during charge events.

PERIODIC WAKE-UP

The HTCM will send a wake-up command on the WAKE-UP COMMAND line to the BPM every six hours, the BPM will then wake-up to check the state of the auxiliary battery. If the auxiliary battery has a low state of charge the BPM will command the accessory A/C and D/C power module (APM) to wake-up and charge the auxiliary battery for fifteen minutes. If the auxiliary battery state of charge is within the acceptable parameters the HTCM and BPM will go back to sleep.

BATTERY PACK

The drive motor battery assembly (battery pack) contains 26 battery modules, a drive motor battery pack control module (BPM), an auto disconnect (AD) system, and a manual disconnect system. The main function of the battery pack is to provide energy to the power inverter module (PIM) to be converted to AC power for the drive motor.

The 26 battery modules are wired in series along with a shunt, fuse, and manual disconnect. This series circuit is then tied to two high voltage relays which are controlled by the AD controller. Under normal operation the relays will remain closed even after the vehicle has been placed in the Lock mode. When a related fault is detected or the manual disconnect knob has been pulled, the relays will open allowing the high voltage to be contained only in the battery pack.

When the vehicle is placed in the run mode and the high voltage relays are open, the AD will close the negative bus high voltage relay and precharge a capacitor in the PIM. Once the capacitor is charged to 90 percent of the battery pack voltage the positive side high voltage relay will close allowing high voltage to be connected to the P1M for use as drive motor power.

BATTERIES

Batteries are energy storage devices used to convert chemical energy into electrical energy through chemical reactions. The EV1 batteries are a valve regulated lead acid (VRLA) battery. These batteries contain only a small amount of liquid which is predominately absorbed by the glass matte material. Where in a typical automotive battery the cells are flooded. The VRLA battery contains six cells at two volts each which provides an overall battery module voltage of 12 volts. In each cell are positive and negative lead plates with lead sulfate as a paste coating. The positive plates are placed in a absorptive glass matte material which contains the sulfuric acid as the electrolyte. The chemical reaction is between lead, lead oxide and sulfuric acid. After the reaction takes place lead sulfate and water are produced. As the battery is discharged, the sulfuric acid decreases and therefore the battery voltage decreases. VRLA batteries have a limited amount of acid available as compared to regular automotive battery which have flooded cells.

The VRLA batteries should not operate consistently at a low state of charge. Operating in this region will cause build up on the plates. The plate build up reduces the amount of active material therefore reducing the capacity of the battery. Additionally, batteries subjected to extreme gassing will tend to dry out the batteries and can reduce the capacity, and life of the battery.

BATTERY CAPACITY

Capacity is the amount of energy the battery module can deliver at a given battery voltage. The capacity is measured in amp-hours. Which is how many amps the battery can deliver over a period of time. The VRLA have a nominal amp-hour capacity of 48 amp-hours. The capacity will increase to approximately 52 amp-hours over the first 100 to 200 charge/discharge cycles and then gradually decrease until the capacity no longer meets the needs of the vehicle operator.

Capacity is affected by many factors: temperature, manufacturing, rate of discharge and the normal chemical process over time.

- Temperature has one of the greatest effects on the battery module. When temperatures are warm the fluid is thin and the chemical reaction takes place much easier than in cold temperatures. In cold temperatures the capacity can be cut in half until the battery temperature increases. The loss of capacity due to temperature is only temporary. As the battery temperature increases the capacity will continue to increases to its maximum capacity. Although the battery capacity increases with warmer temperatures there is a negative impact if batteries are ran at temperatures of 60°C (140°F) and above. At these temperatures battery corrosion is accelerated and can impact the life of the battery.
- Manufacturing of the battery module also plays a part in there overall capacity. If one battery module is manufactured with more active material that battery module has a potential of additional capacity.
- The rate the battery module is discharged can also effect the capacity of the battery module. The slower the battery module is discharged the more time allowed for the material to react and stay active. Discharging the battery at a very high rate will prevent some of the material from reacting; therefore, reducing the overall capacity.
- In the normal chemical process over time, the material breaks down and is consumed allowing the amount of active material to be reduced. The reduction of this active material reduces the capacity of the battery module.

Because the batteries in the EV1 are wired in series the amount of amp-hours in a battery pack is controlled by the battery module with the lowest amp-hour capacity. The performance of the battery is not affected by the capacity; however, the range, or amount of miles the vehicle can travel is directly affected by the capacity. The capacity will decrease overtime at different rates depending on how the vehicle is operated and how the battery modules were made. If vehicle mileage demands are low, than a reduction in capacity will not be noticed by the vehicle operator. However, if vehicle mileage demands are high, the vehicle operator will notice a overall reduction in miles per charge.

BATTERY CYCLE LIFE

The battery cycle life is the amount of charge/discharge cycles a battery can take before it no longer meets the minimum capacity requirements. One significant factor in cycle life is corrosion which is caused by oxidation and hydrogen reduction. The corrosion process is accelerated when the vehicle is operated in high temperatures. Another significant factor in cycle life is the depth of discharge. The deeper the discharge the harder it becomes to reverse the chemical reaction when charging. This can reduce the amount of material available for use in the next drive cycle.

BATTERY STATE OF CHARGE

Battery state of charge (SOC) is the ratio of remaining battery pack amp hours to battery pack capacity. State of charge is stated in a percentage.

- Pack state of charge (PSOC): Represents the percentage of total battery pack energy.
- User state of charge (USOC): Represents the percentage of the total battery pack energy minus a calibrated amount of reserve.

  0% USOC = 15% PSOC

BATTERY CHARGING

When the charge coupler is installed into the charge receptacle the battery pack module (BPM) is sent a wake-up signal from the charge receptacle. The battery pack module (BPM) will go through a set of checks with the charger via the charge receptacle who passes the information to the charger by way of a communication system (like a radio signal is sent). There is no hard wiring between the charger and the charge receptacle. When charger and BPM initialization is complete the BPM and charger pass system status. Next, the BPM will request a percentage of maximum power required for charging. This request is updated as the vehicle charges to complete. The power from the charge receptacle passes through the PIM to the battery pack.

Battery charging is based on pack voltage, module voltage, charge port temperature, battery pack temperature and auxiliary battery voltage. The BPM continually monitors the above values and adjusts its request of power to the charger as the vehicle charges.

BATTERY PACK CONTROL

The drive motor BPM monitors each of the 26 modules separately. This is accomplished by sense leads connected at each module positive terminal. The BPM will initialize the sense leads to read across one battery module at a time. The sense leads are placed across a capacitor inside the BPM which is charged to the voltage potential of the battery module being measured. Once the capacitor is charged the BPM will read the voltage across the capacitor and compare it to the normalized module voltage. Normalized module voltage is calculated by reading battery pack voltage at a point in time and dividing by 26. If the BPM module voltage is a calibrated delta from the normalized voltage, a low voltage compared to current draw or less than one volt the BPM will set a code indicating a battery module or system problem.

BATTERY PACK CURRENT SHUNT

Additionally the BPM measures current by using a shunt. A shunt is a precision resistor with a known value. The BPM uses the voltage reading across the shunt and the known resistance to calculate the current entering or exiting the battery pack. This information is used for charging, SOC and range calculations and diagnostics.

The current shunt will have an accuracy of+/−0.5 amps at 0 − 17 amps draw and +/−3 percent at greater than 17 percent draw.

Resistance:	0.40 milliohms
Nominal voltage:	312 volts
Maximum voltage:	430 volts
Minimum voltage:	225 volts
Nominal current:	50 amps
Maximum current:	175 amps for two minutes 472 amps for 15 seconds

PACK VOLTAGE SENSE

Battery pack voltage is also measured by two sense leads, one at module #1 and the other at module #26. This voltage is monitored by the battery pack module (BPM) and used for pack control and diagnostics.

The battery pack is protected by a fuse with the following ratings:

- 472 amps at 343 volts for 30 seconds minimum
- Minimum fuse voltage rating: 500 volts

BATTERY PACK AUTO DISCONNECT SYSTEM

The battery pack module (BPM) also reports any failures detected by the automatic disconnect (AD) system. This is accomplished by three status lines that are pulled low by the AD control module. Below is a list defining the different states of the AD state lines.

STATUS	LINE I	LINE 2	LINE 3	AD PWR SUPPLY
OK	0V	0V	0V	5V
LOSS OF ISOLATION	5V	5V	5V	5V
GROUND LOSS	5V	5V	0V	5V
INTERLOCK	0V	5V	5V	5V
LOW PACK VOLTAGE	5V	0V	5V	5V
BPM COMMANDED OPEN	0V	5V	0V	5V
CAPACITOR PRECHARGE	5V	0V	0V	5V
CAPACITOR PRECHARGE FAIL	0V	0V	5V	5V

BATTERY PACK TEMPERATURE CONTROL

The BPM also monitors the six temperature sensors. This information is used to calculate battery energy, SOC and overtemp conditions. The pack also contains an inlet air temperature and an air flow sensor. The air inlet sensor monitors the incoming air temperature from the cooling system. The air flow sensor detects the presence of air circulating through the pack.

SIGNAL LINES TO VEHICLE/FROM BPM

There are 14 signal lines that run outside of the battery pack. The function of these 14 signals are as follows:

1. **12 VOLT POWER:** 12 volt power from the auxiliary battery for processor logic.
2. **RUN 1:** Is a discrete signal (input) to the auto disconnect to activate the PIM capacitor recharge command and is also a redundant vehicle wake-up command to the BPM.
3. **PARK STATUS:** Is a discrete input to indicate if the vehicle is in park. This information is used to allow charging only in park.
4. **AD POWER SUPPLY:** 12 volt power from the auto disconnect used to power the battery recovery switch.
5. **VEHICLE WAKE-UP COMMAND:** 12 volt wake-up signal supplied to wake up the BPM. Can also be initiated by the BPM to wake up HPVS/thermal control module (HTCM) and APM. The BPM receives the wake up signal from the HTCM periodically (vehicle in the lock mode and no charging), this allows the BPM to run the cooling fan and purge the battery pack tunnel of any gasses that may be present.

6. **CHARGE RECEPTACLE TEMPERATURE:** Used by the BPM to monitor charge receptacle temperature and detect if the charge coupler is present. BPM will not initiate charging unless coupler is present and temperature is less than 60°C (140°F).
7. **CLASS II SERIAL DATA:** Used by the BPM to send and receive messages to and from the charger. This enables BPM to control output power from the charger.
8. **SERIAL DATA UART:** Used by all of the modules to communicate information: The BPM is the master of the bus and commands all messages to be sent.
9. **AUXILIARY POWER SUPPLY (APS) OUTPUT COMMAND:** This is a command from the BPM to the APM for auxiliary battery charging. The BPM can command 13.5 or 14.5 volts depending on the temperature. The BPM will command 14.5 volts when the temperature falls below 15°C (59°F).
10. **ACCY RETURN:** This is chassis ground for the BPM with a redundant connection to AD chassis ground.
11. **PACK COOL:** This is a PWM signal used to command the battery cooling fan ON. The fan will be commanded on for 1.25 minutes when the vehicle is placed in the Run mode, when battery temperature exceeds 58°C (136°F) or during charging.
12. **AD CHASSIS GROUND:** The accessory return power signal provides chassis ground reference for the AD isolation protection. The AD monitors this line for continuity. If the wire is open the AD can no longer detect loss of isolation. The AD will terminate all functions and open the high voltage relays. This information will be reported to the BPM via the state lines.
13. **AD GROUND SENSE:** The ground sense power signal provides the interior ground reference for the AD isolation protection. The AD monitors this line for continuity. If the wire is open the AD can no longer detect loss of isolation. The AD will terminate all functions and open the high voltage relays. This information will be reported to the BPM via the state lines.
14. **RUN 1/WAKE-UP:** This signal supplies the battery pack fan airflow detect sensor with auxiliary battery voltage, during Run mode and Charge mode.

BATTERY PACK VENT SYSTEM

The battery pack has a vent system which plays a very critical roll in assuring no gases are allowed to build up in the battery tunnel. Every battery is connected to the vent system. The system routes through all of the batteries and out the front of the battery pack, and is strapped on to the high voltage cable. On the end of the vent tube is a filter used to keep the system clean from contaminates. The material used for the vent system is a special material and should never be substituted with any other material. Use only genuine GM Parts for this application. Whenever the battery pack is worked on, make sure the vent system check is performed to ensure the vent system is working correctly.

DRIVE MOTOR BATTERY PACK MODULE

The drive motor battery pack module (BPM) does all the calculations for range in miles and the state of charge (SOC) bars. This information is reported to instrument panel cluster (IPC) by serial data. The SOC bars represents how much usable energy is in the batteries. The range gage represents how many miles left based on usable energy and current driving style. Both of these are adaptive and will change based on temperature, driving habits and charging.

STATE OF CHARGE (SOC)

The state of charge (SOC) of the batteries is represented on the instrument panel cluster (IPC) by the SOC bars. The amount of the state of charge is divided equally by the 11 bars. The SOC is the ratio of the present number of amp-hours in the battery pack minus a reserve to the full rated amount of 48 amp-hours minus the same reserve.

The SOC is constantly changing based on inputs to the BPM. The factors that affect the SOC are:

- Average battery pack temperature
- Lowest battery module voltage and current
- Pack voltage
- Amp-hours lost due to BP self discharge
- Amp-hours lost due to parasitic
- Age of the batteries
- Amp-hours used
- Average current usage
- BP capacity
- BP capability

The BPM stores the last rated, usable energy that a pack has whenever the charging complete criteria is met. From this point the BPM is continually summing up how many amp-hours are flowing into and out of the battery pack.

The summing of discharging amp-hours is corrected for the temperature of the pack, the lowest battery module and the rate (amps) at which current is flowing out of the batteries. The higher the temperature, the less each amp-hour counts, warm batteries react easier and are more efficient. The greater the rate (the more accelerator input), the more each amp-hour count. With the batteries being in a series string the weak link controls the energy of the entire battery pack. If one module is at 35 amp-hours and the rest of the modules are at 48 amp-hours the usable energy from the pack is only 35 amp-hours.

During charging the amp-hours going into the pack are summed up until the completion criteria is met.

Because the battery is a chemical reaction, as with all chemical reactions, the temperature of the pack has an absolute affect on the SOC. Therefore, the SOC will be compensated to a proportionally lower value for battery pack temperatures below 27°C (81°F).

RANGE

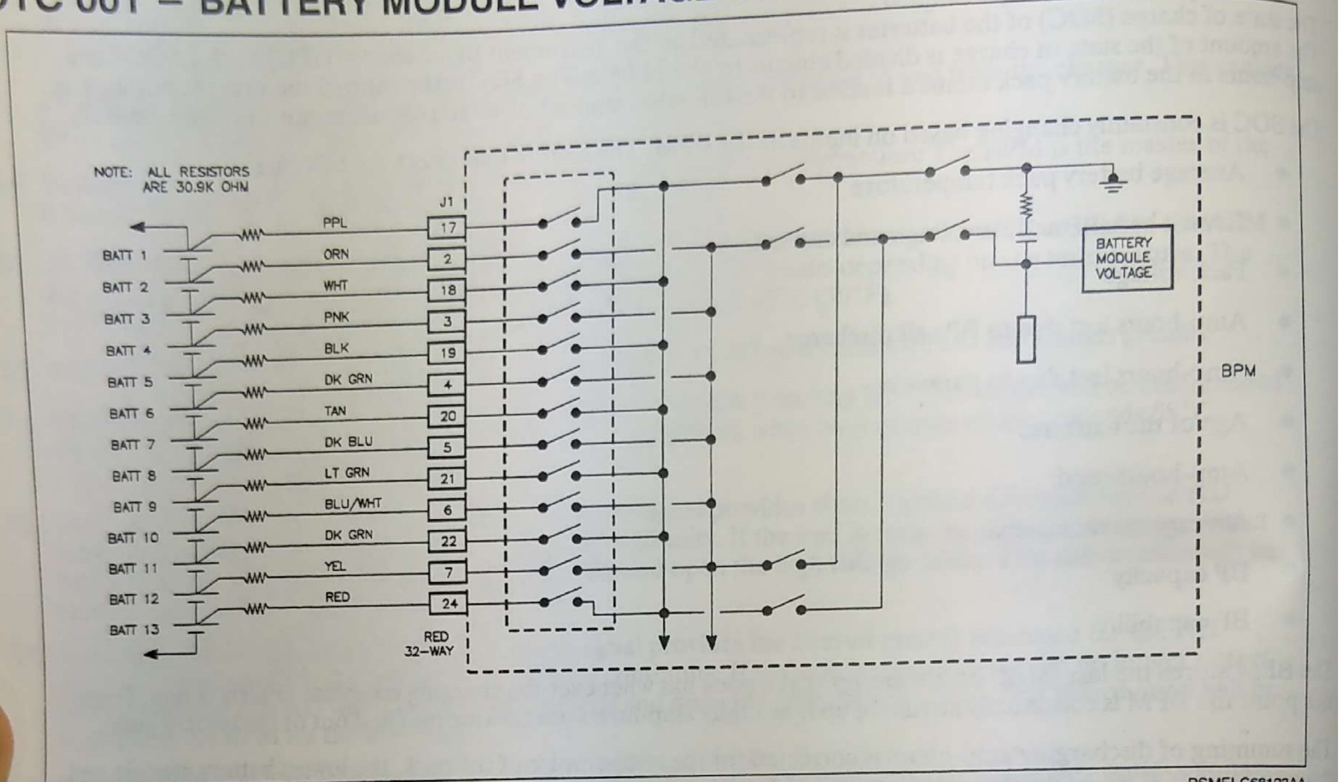
The range display on the instrument panel cluster (IPC) is the economy ratio, kilometers per amp-hour multiplied by the amount of usable amp-hours left in the batteries. As the vehicle is driven the range gage is constantly adapting to driving style and other variables or conditions the battery pack is experiencing. The items that affect range are:

- Average BP temperature
- Lowest module current and voltage
- Rate of current output
- Vehicle speed
- Distance traveled per amp-hour (per this trip)
- Battery pack capability
- Battery pack capacity

The BPM is continually summing up how many kilometers the vehicle has traveled and how many amp-hours it has used to travel this distance. The ratio of kilometers per amp-hours is then multiplied by the number of amp-hours remaining in the pack to predict the number of kilometers that the vehicle can travel.

When the vehicle is charged to complete the range, gage will display the estimated range based on the last drive cycle. However, if the vehicle was to sit overnight and the ambient temperature dropped, the range will be reduced even though the vehicle had not been driven.

DTC 001 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #1)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

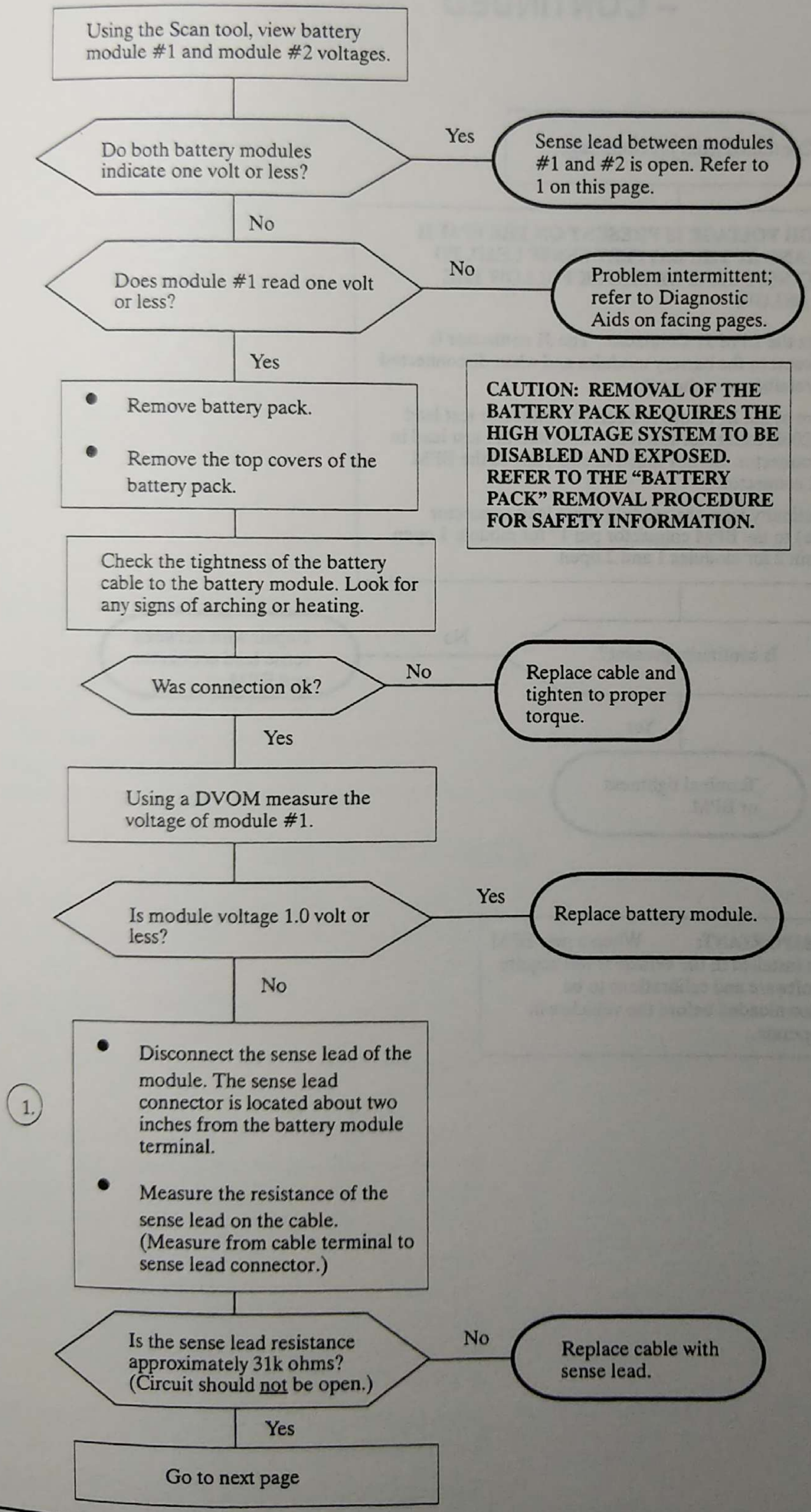
DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0–0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:
  1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
  2. Under "HIGH" discharge current (Heavy Load).
  3. When battery module state of charge (SOC) is "LOW."
- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 001
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #1)

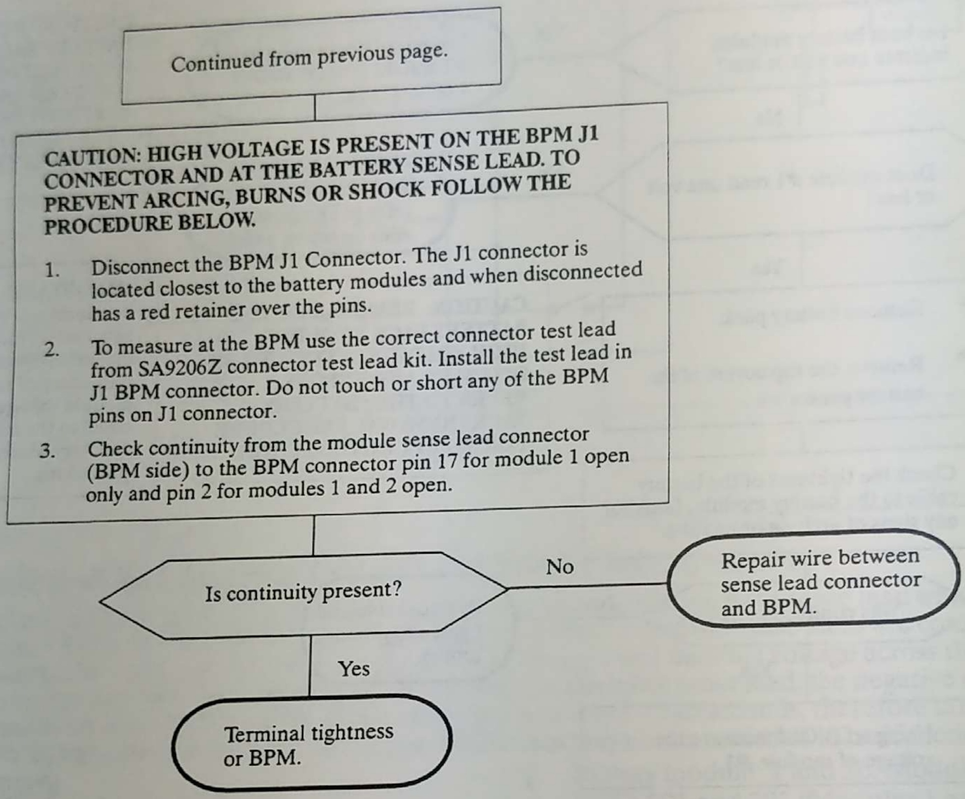

Using the Scan tool, view battery module #1 and module #2 voltages.
Do both battery modules indicate one volt or less?
Yes
Sense lead between modules #1 and #2 is open. Refer to 1 on this page.
No
Does module #1 read one volt or less?
No
Problem intermittent; refer to Diagnostic Aids on facing pages.
Yes
Remove battery pack.
Remove the top covers of the battery pack.
Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.
Was connection ok?
No
Replace cable and tighten to proper torque.
Yes
Using a DVOM measure the voltage of module #1.
Is module voltage 1.0 volt or less?
Yes
Replace battery module.
No
1.
Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)
Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)
No
Replace cable with sense lead.
Yes
Go to next page

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 001
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #1) – CONTINUED



Continued from previous page.

CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

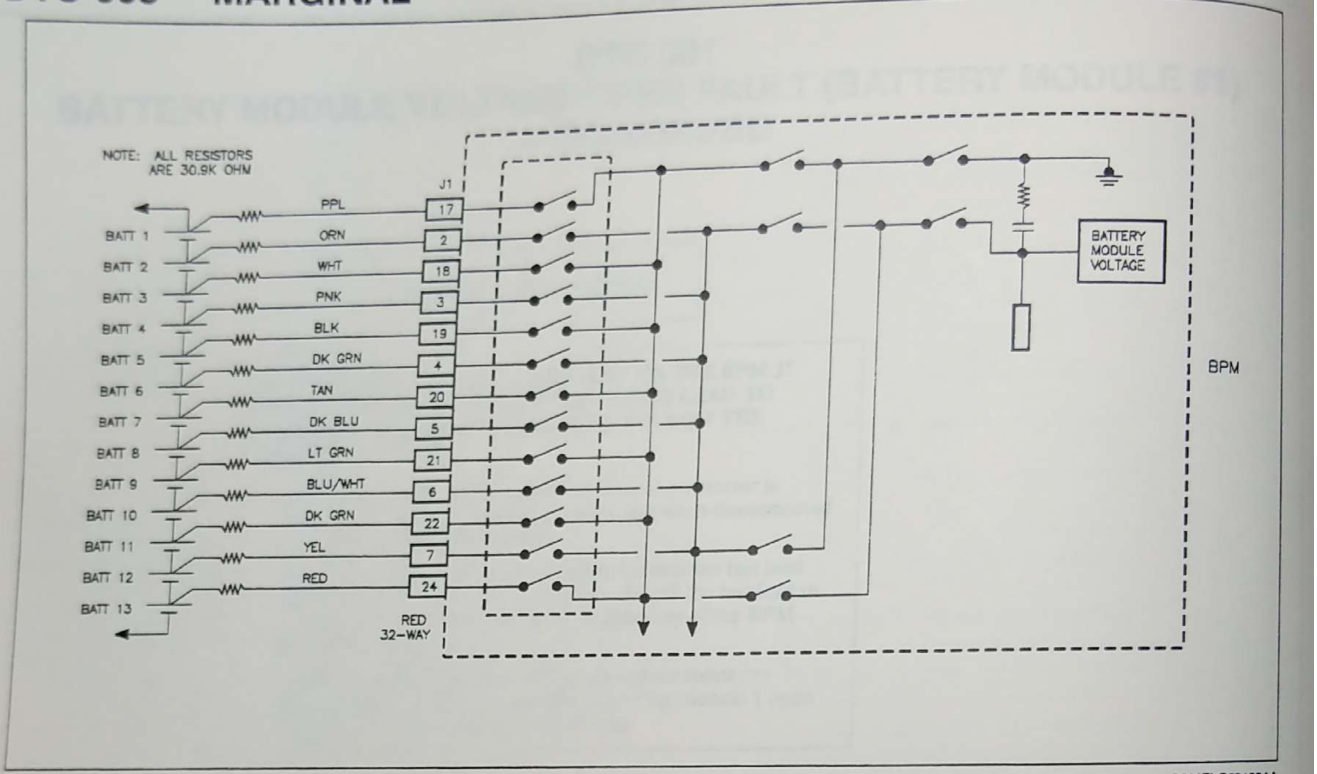
1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

Is continuity present?
No
Repair wire between sense lead connector and BPM.
Yes
Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 003 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #1)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is 0 to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #1: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

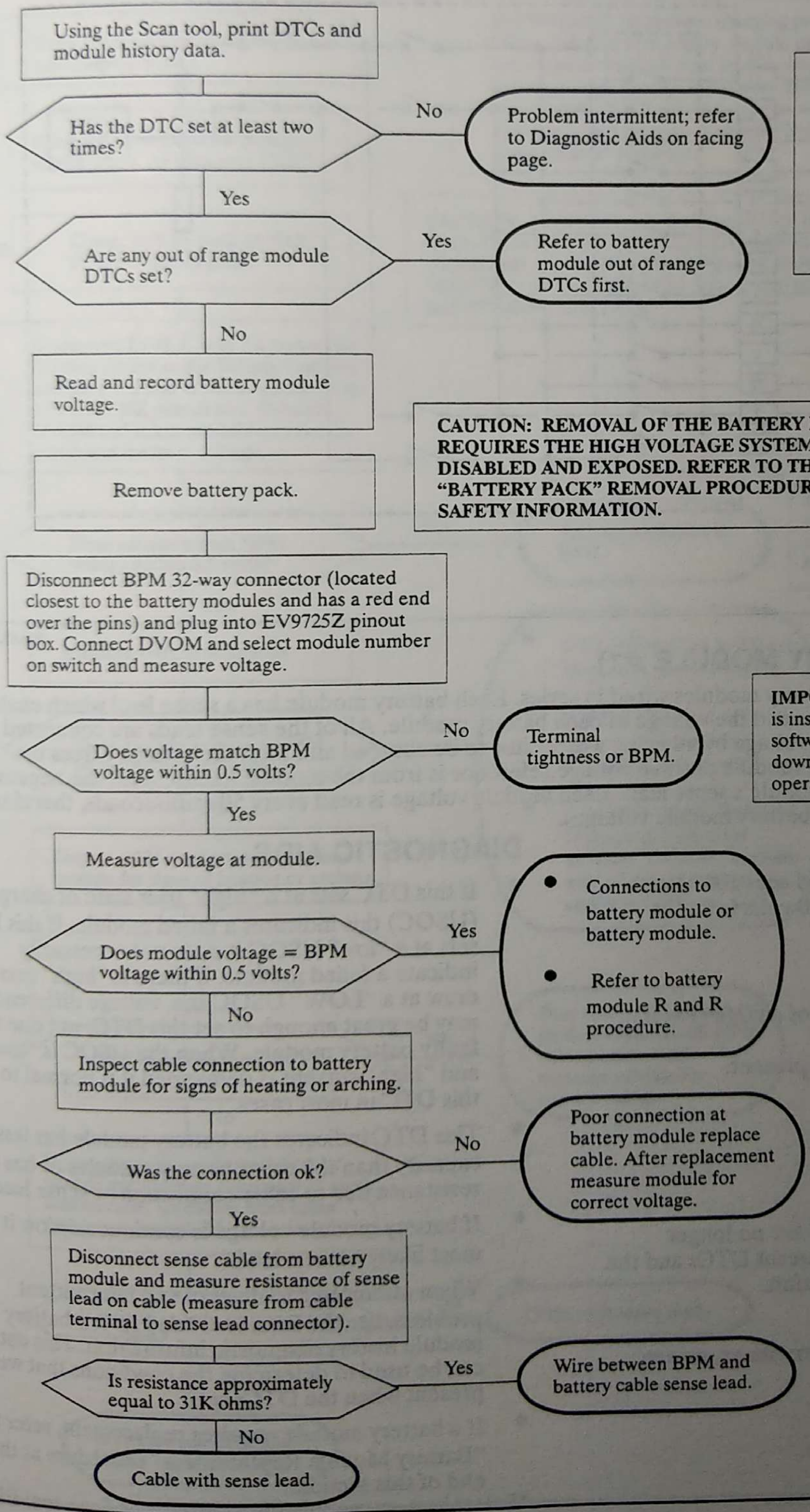
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section..
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module history from the Scan tool BPM menu.

DTC 003
MARGINAL (BATTERY MODULE #1)


Using the Scan tool, print DTCs and module history data.
Has the DTC set at least two times?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any out of range module DTCs set?
Yes
Refer to battery module out of range DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Connections to battery module or battery module.
• Refer to battery module R and R procedure.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).
Is resistance approximately equal to 31K ohms?
Yes
Wire between BPM and battery cable sense lead.
No
Cable with sense lead.

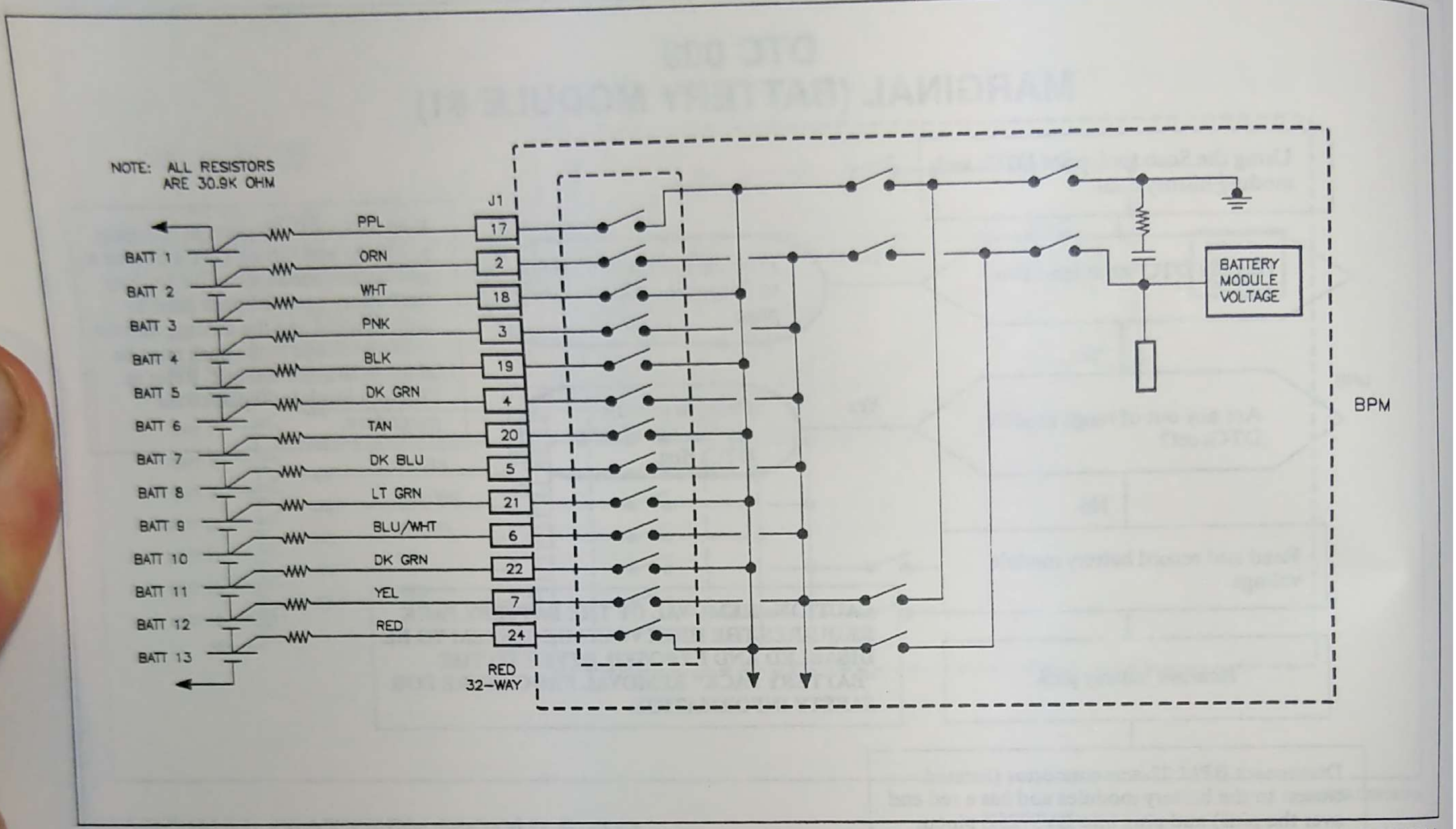
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

CS CamScanner

DTC 004 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #1)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is 0 to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #1: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

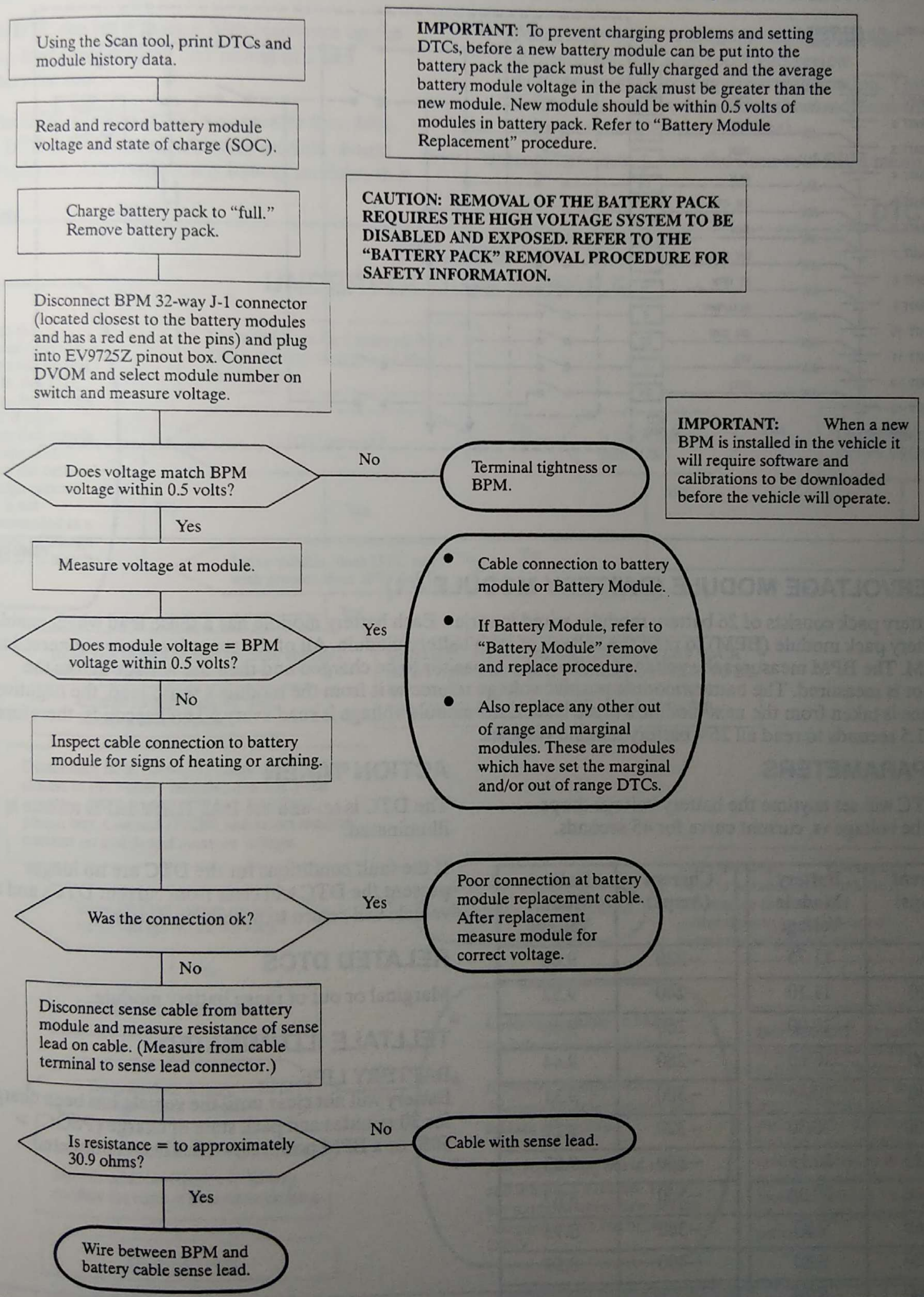
None

DIAGNOSTIC AIDS

- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

*Select battery module history from the Scan tool BPM menu.

DTC 004
OUT OF RANGE (BATTERY MODULE #1)

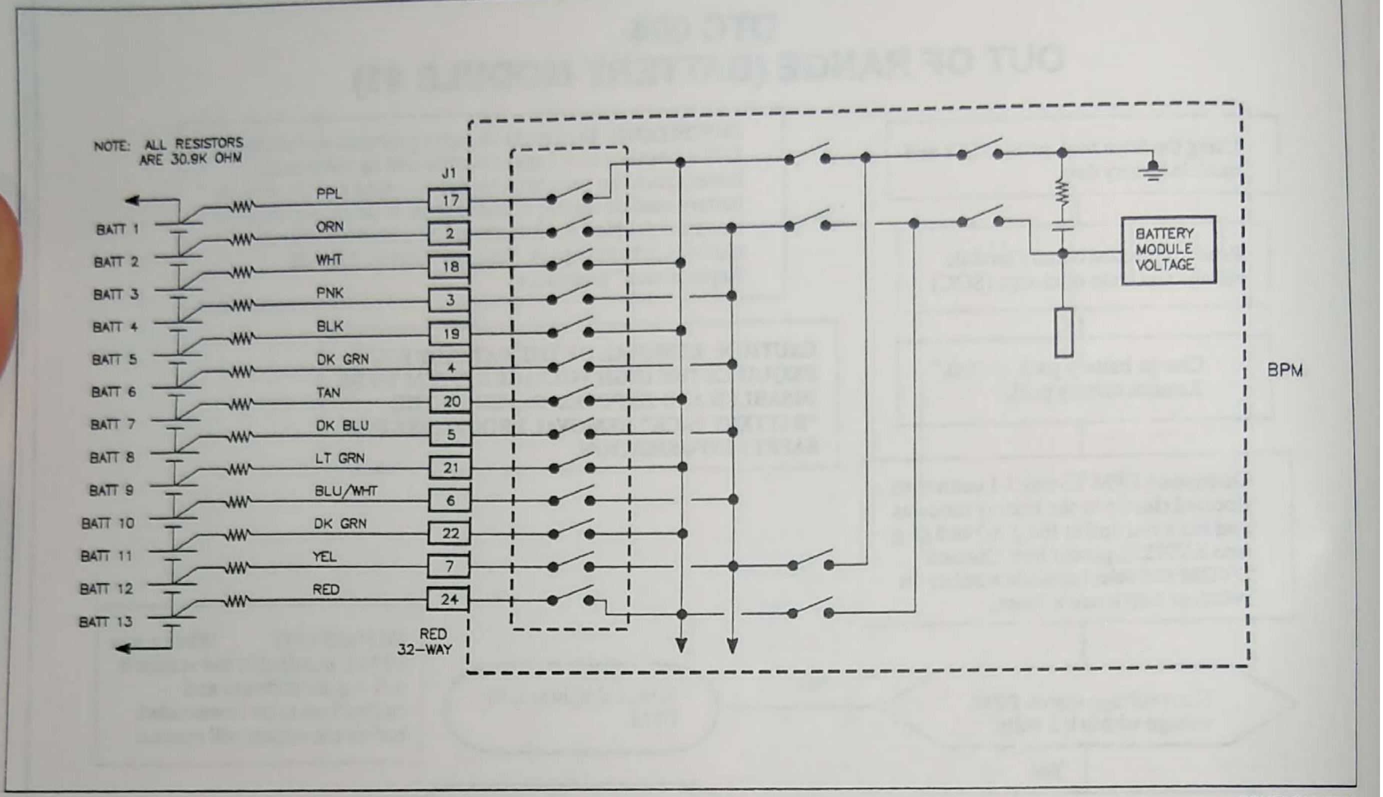

Using the Scan tool, print DTCs and module history data.
Read and record battery module voltage and state of charge (SOC).
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Cable connection to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
Yes
Poor connection at battery module replacement cable. After replacement measure module for correct voltage.
No
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance = to approximately 30.9 ohms?
No
Cable with sense lead.
Yes
Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 005 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32–WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #1)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage
0	11.75
−20	11.10
−40	10.90
−60	10.65
−80	10.45
−100	10.30
−120	10.15
−140	10.00
−160	9.90
−180	9.80
−200	9.70
−220	9.60
−240	9.52
−260	9.48
−280	9.44
−300	9.31
−320	9.17
−340	9.03
−360	8.87
−380	8.73
−400	8.59

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

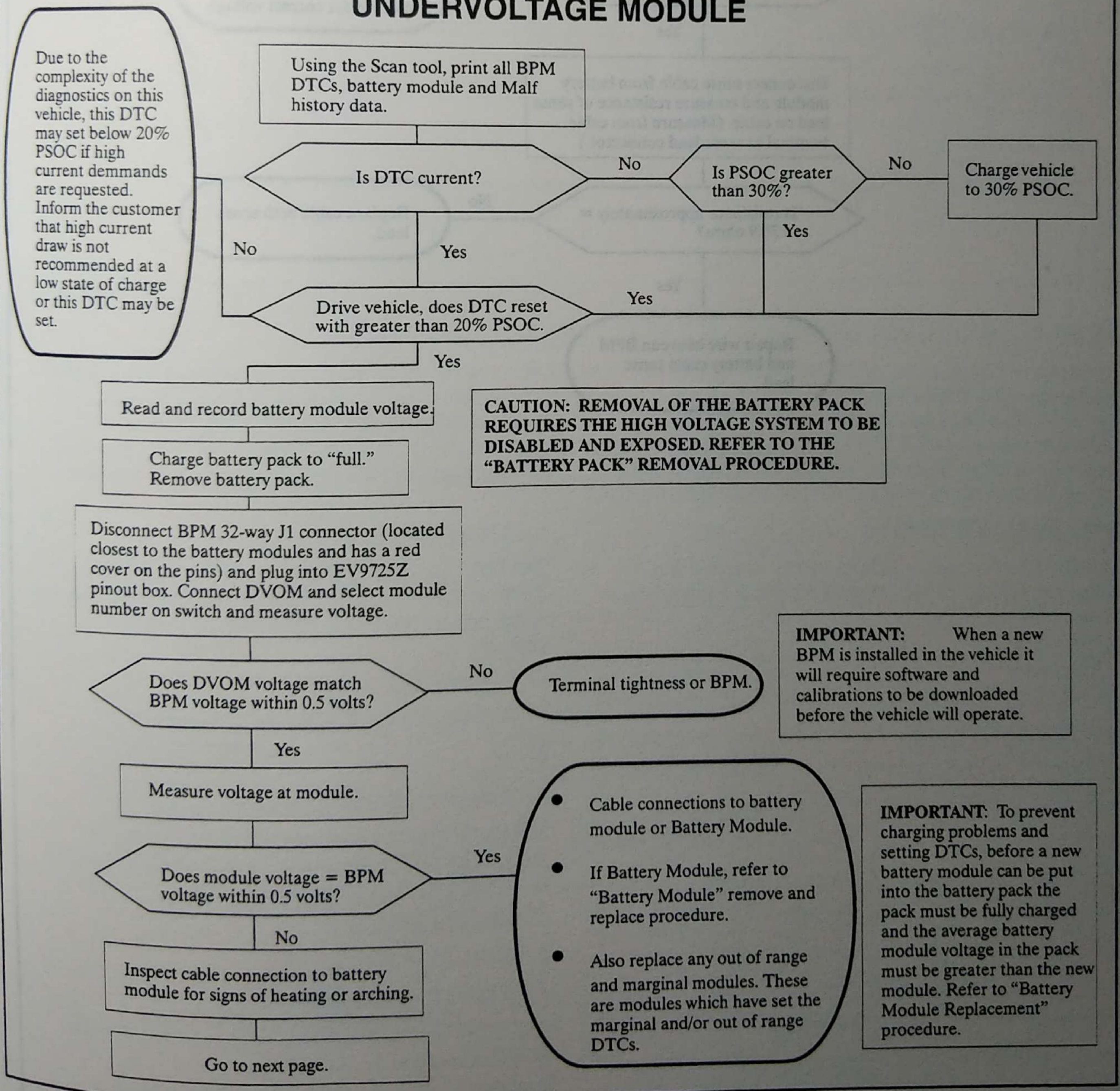
BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below 0% user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 005
UNDERVOLTAGE MODULE

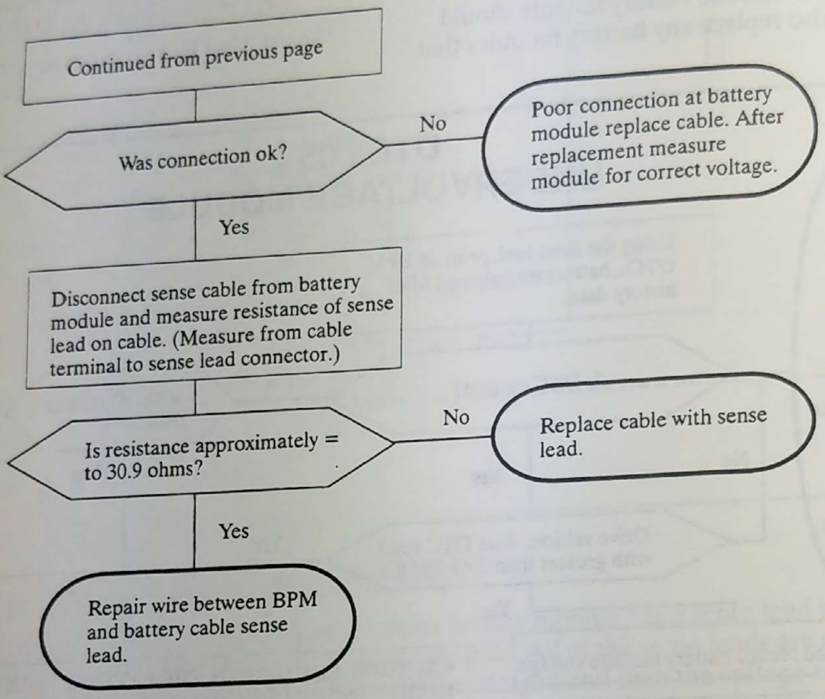

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.
Cable connections to battery module or Battery Module.
If Battery Module, refer to "Battery Module" remove and replace procedure.
Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

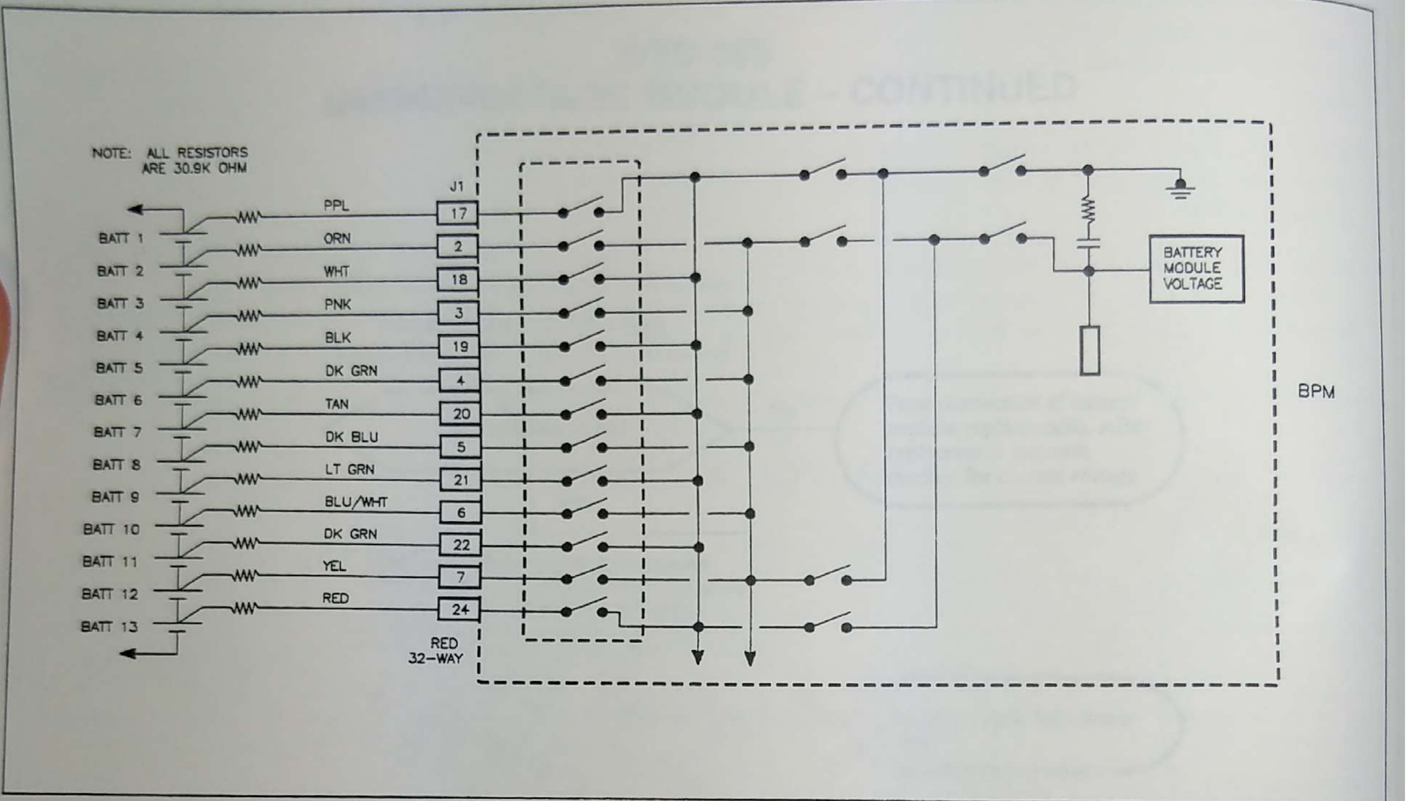
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 005
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 006 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
J1
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #1)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

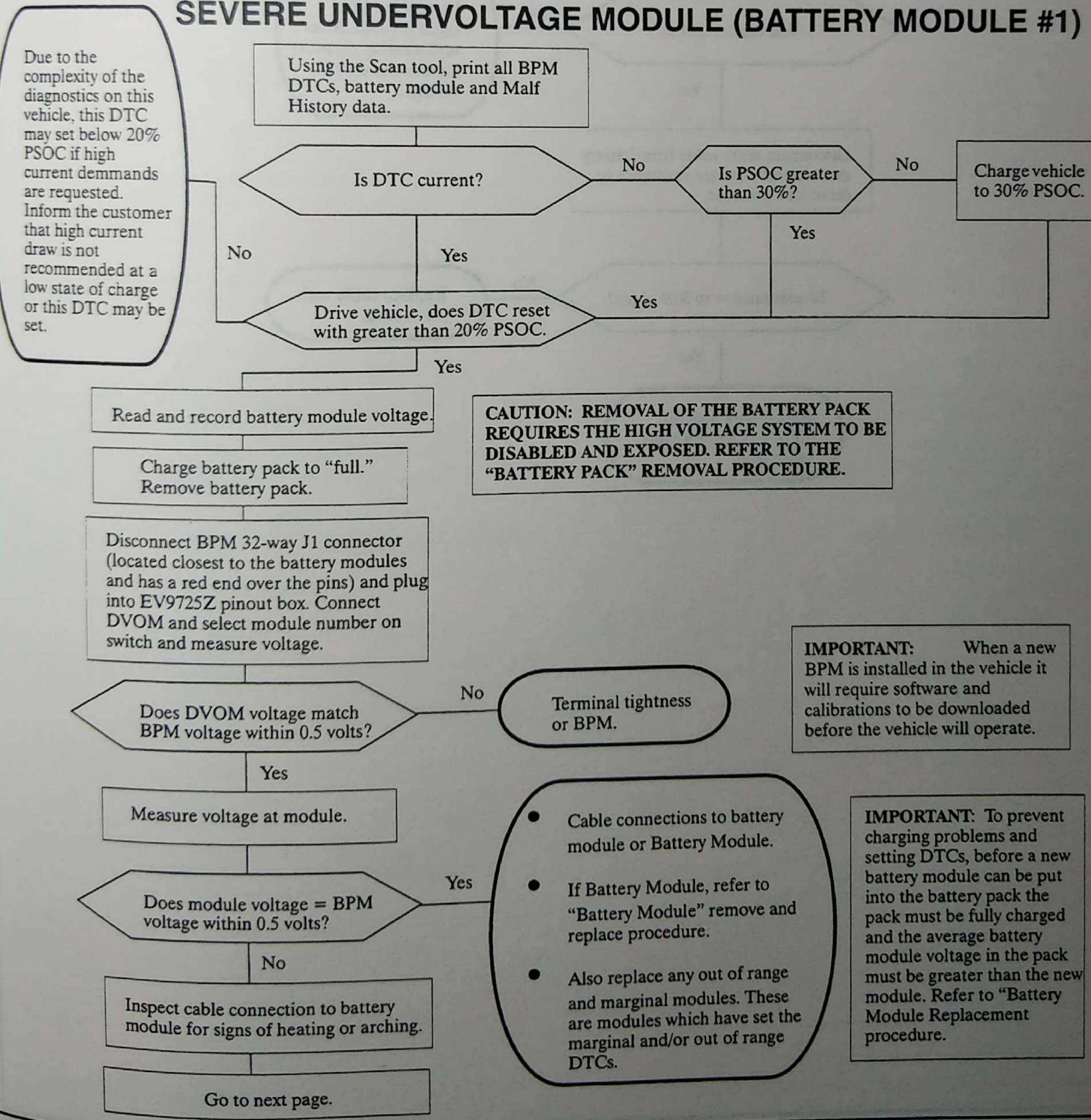
Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches 0% user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 006
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #1)

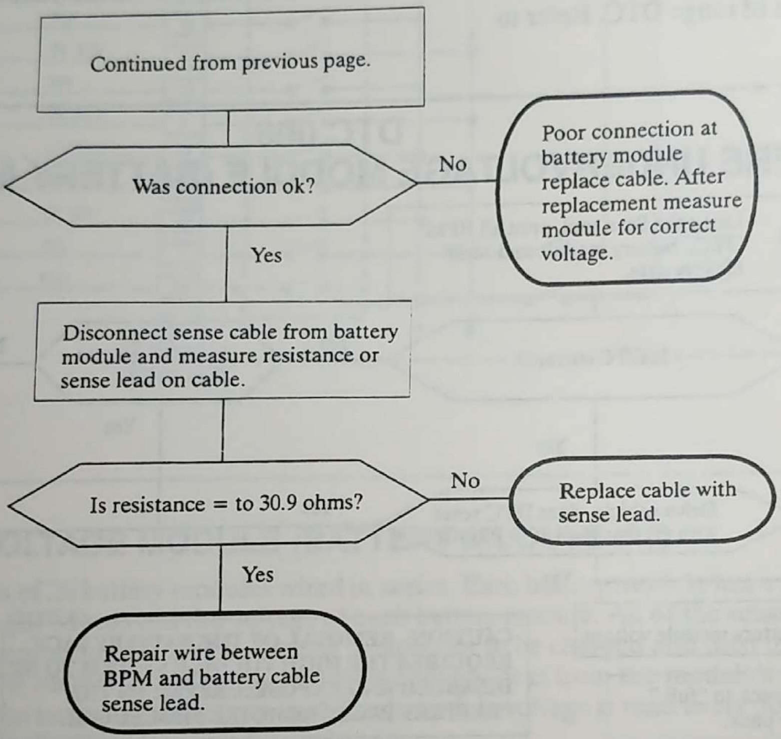

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malf History data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
Cable connections to battery module or Battery Module.
If Battery Module, refer to "Battery Module" remove and replace procedure.
Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

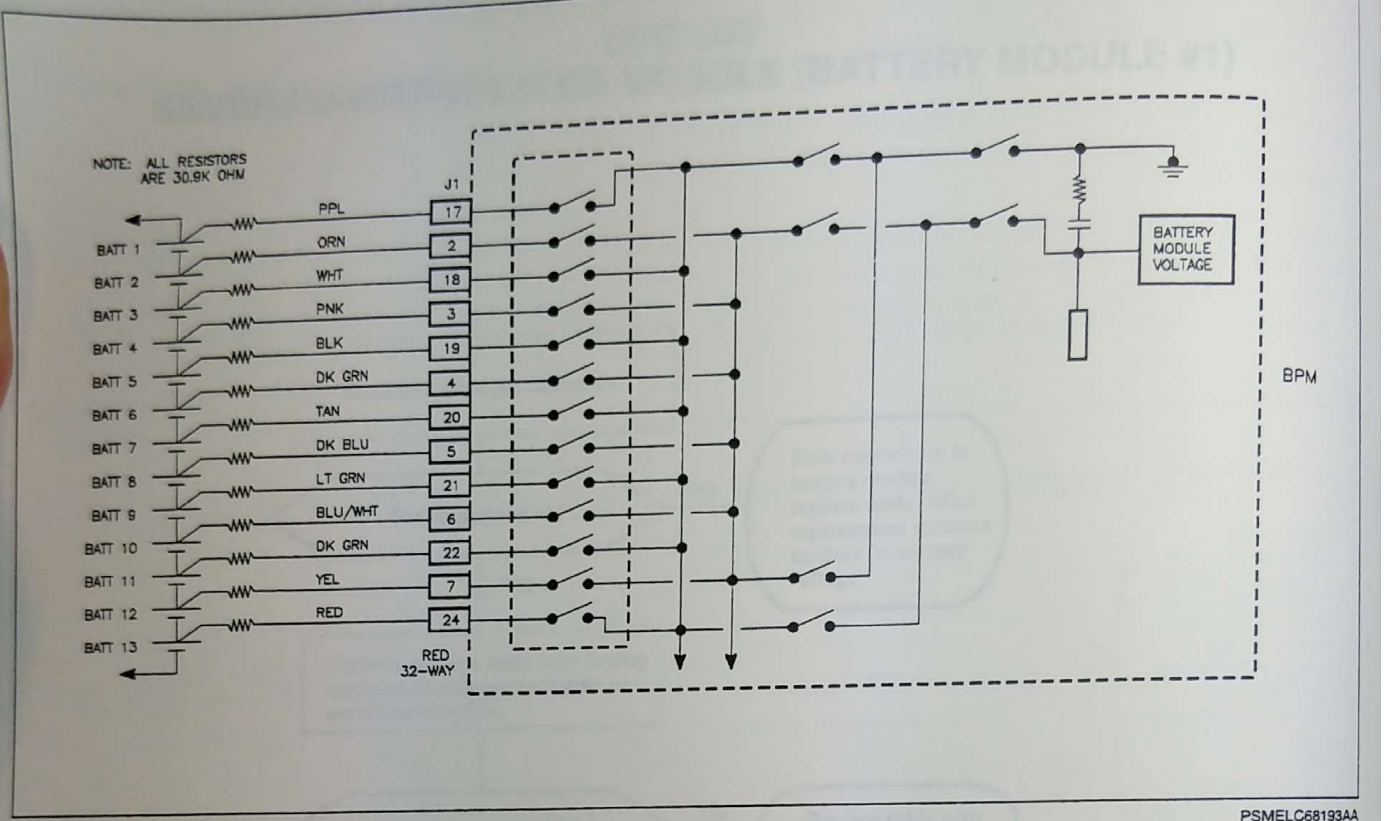
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement procedure.

DTC 006
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #1)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 007 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #1)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

SERVICE NOW and REDUCED PERFORMANCE

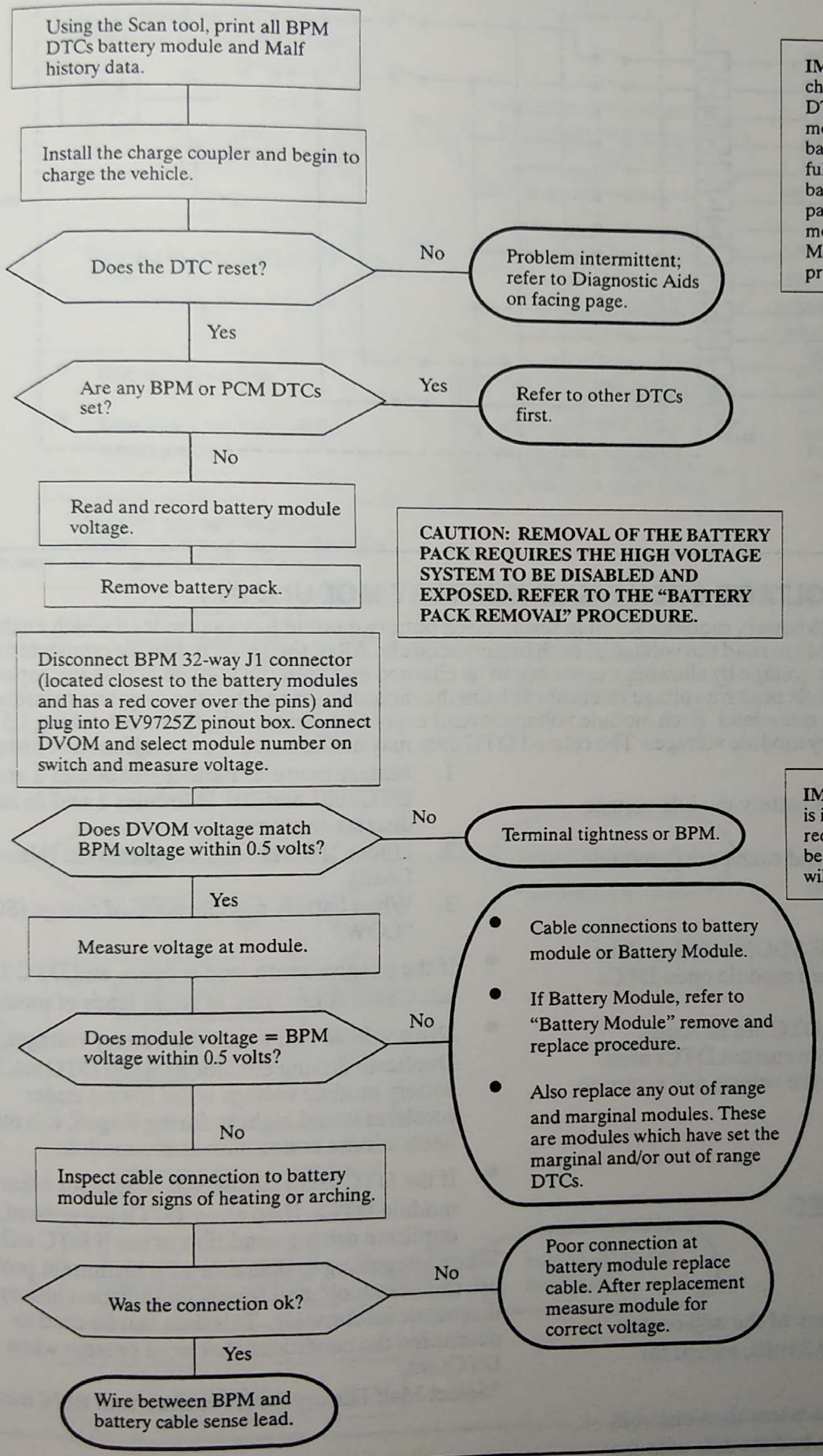
DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

DTC 007
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #1)

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.



Using the Scan tool, print all BPM DTCs battery module and Malf history data.

Install the charge coupler and begin to charge the vehicle.

Does the DTC reset?

Problem intermittent; refer to Diagnostic Aids on facing page.

Are any BPM or PCM DTCs set?

Refer to other DTCs first.

Read and record battery module voltage.

Remove battery pack.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

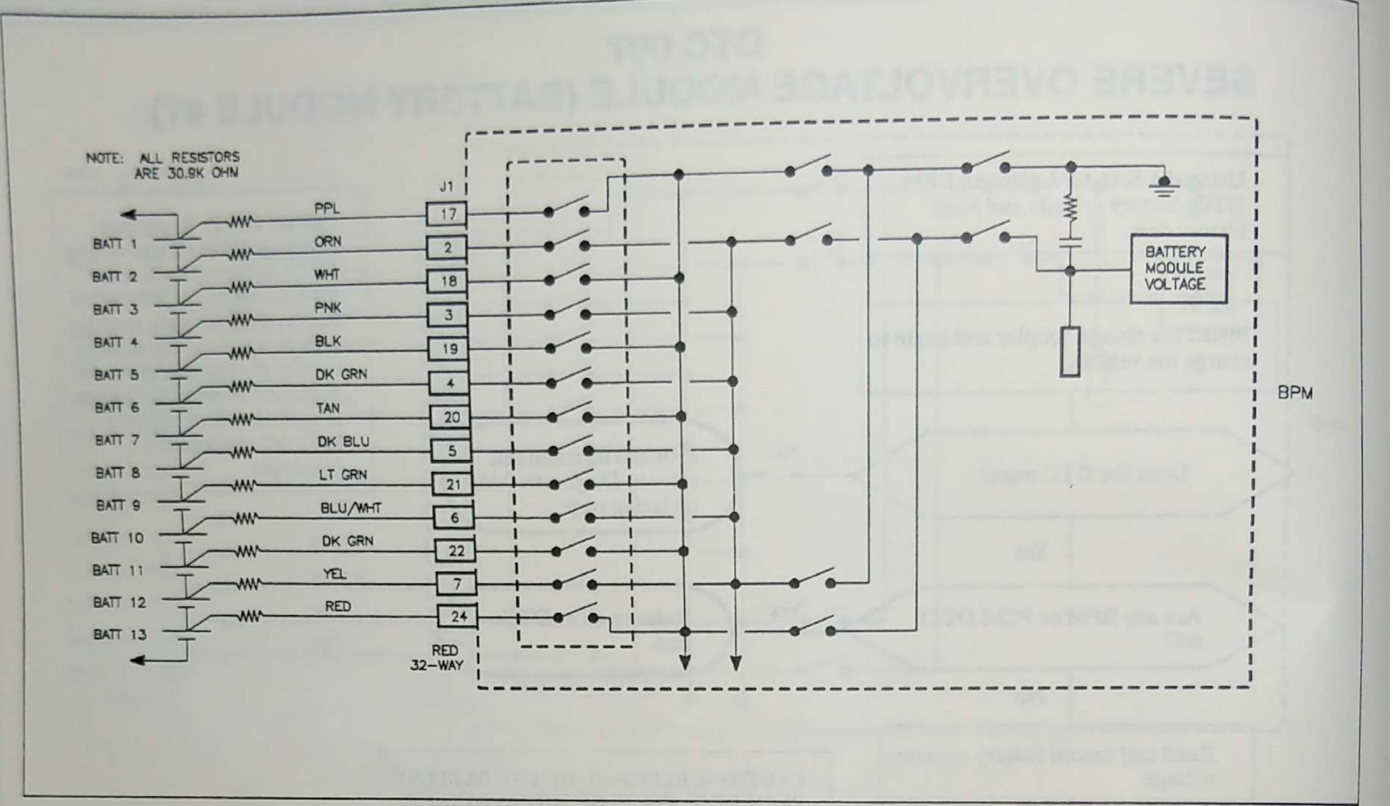
Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Poor connection at battery module replace cable. After replacement measure module for correct voltage.

Wire between BPM and battery cable sense lead.

DTC 009 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #2)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

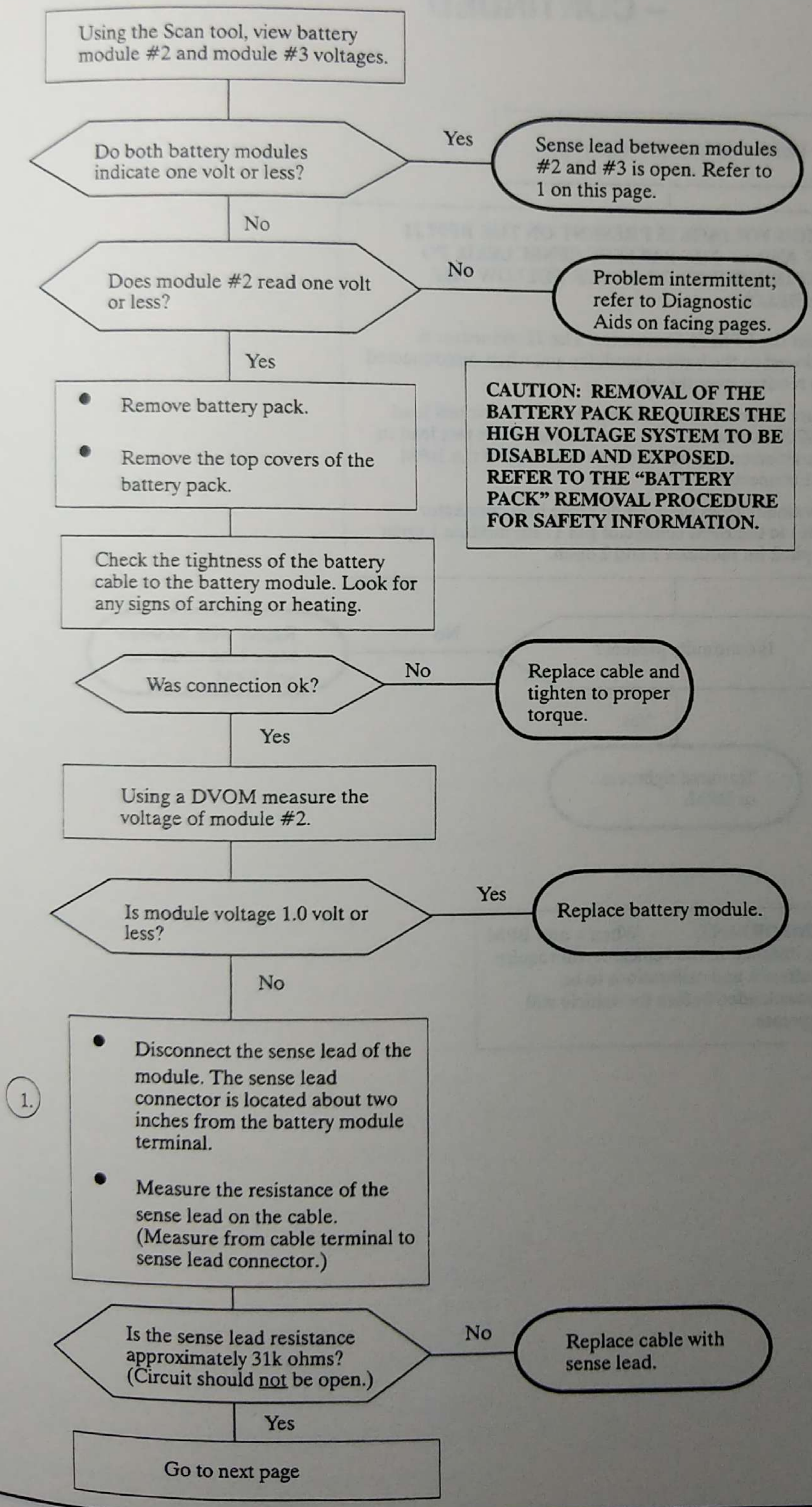
DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:
  1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
  2. Under "HIGH" discharge current (Heavy Load).
  3. When battery module state of charge (SOC) is "LOW."
- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 009
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #2)

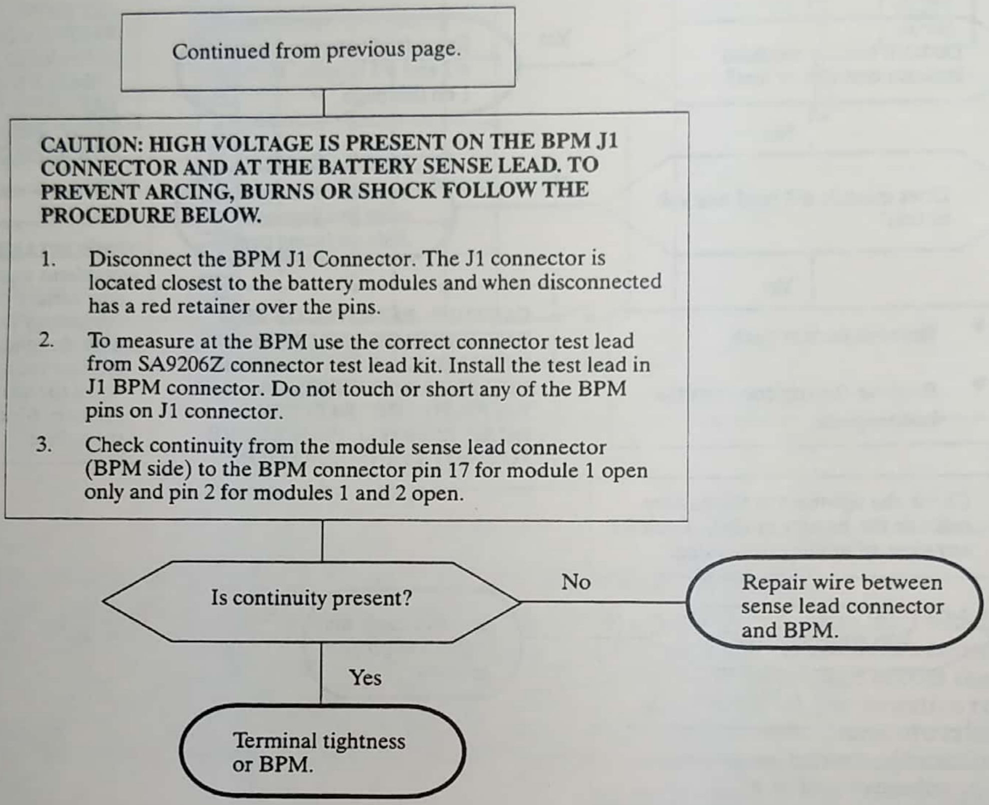

Using the Scan tool, view battery module #2 and module #3 voltages.
Do both battery modules indicate one volt or less?
Yes
Sense lead between modules #2 and #3 is open. Refer to 1 on this page.
No
Does module #2 read one volt or less?
No
Problem intermittent; refer to Diagnostic Aids on facing pages.
Yes
• Remove battery pack.
• Remove the top covers of the battery pack.
Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.
Was connection ok?
No
Replace cable and tighten to proper torque.
Yes
Using a DVOM measure the voltage of module #2.
Is module voltage 1.0 volt or less?
Yes
Replace battery module.
No
1.
• Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
• Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)
Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)
No
Replace cable with sense lead.
Yes
Go to next page

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 009
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #2) – CONTINUED



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CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

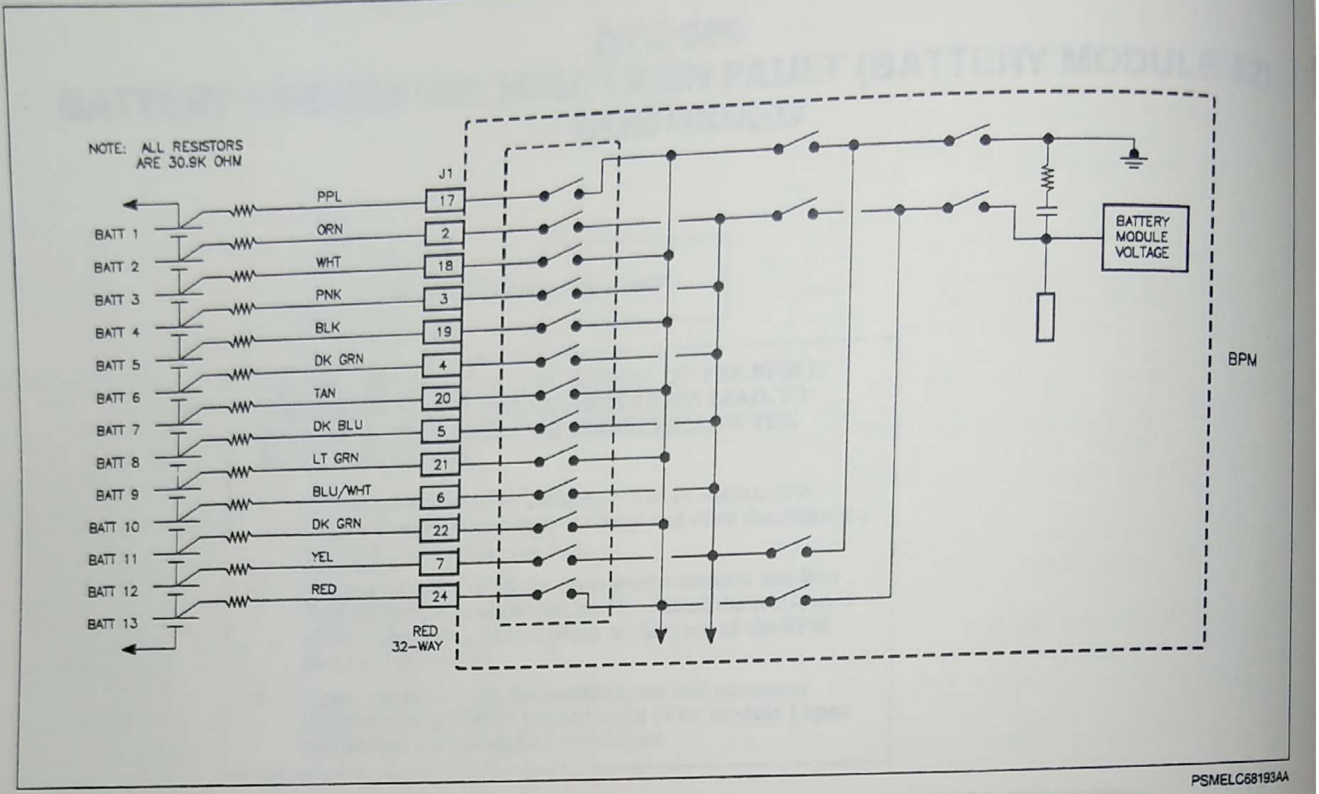
1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

Is continuity present?
No
Repair wire between sense lead connector and BPM.
Yes
Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 011 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #2)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is 0 to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #2 undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

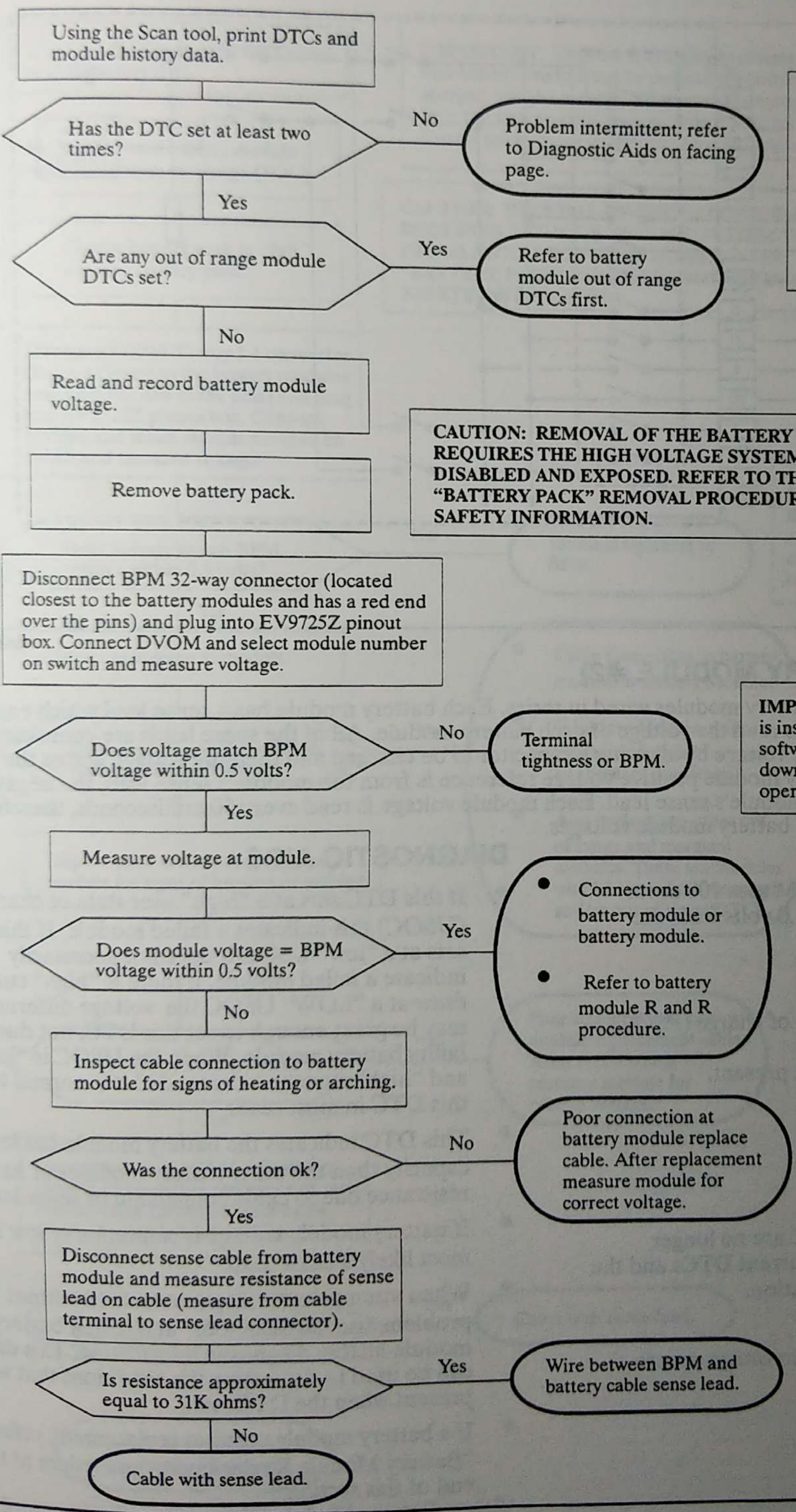
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

DTC 011
MARGINAL (BATTERY MODULE #2)

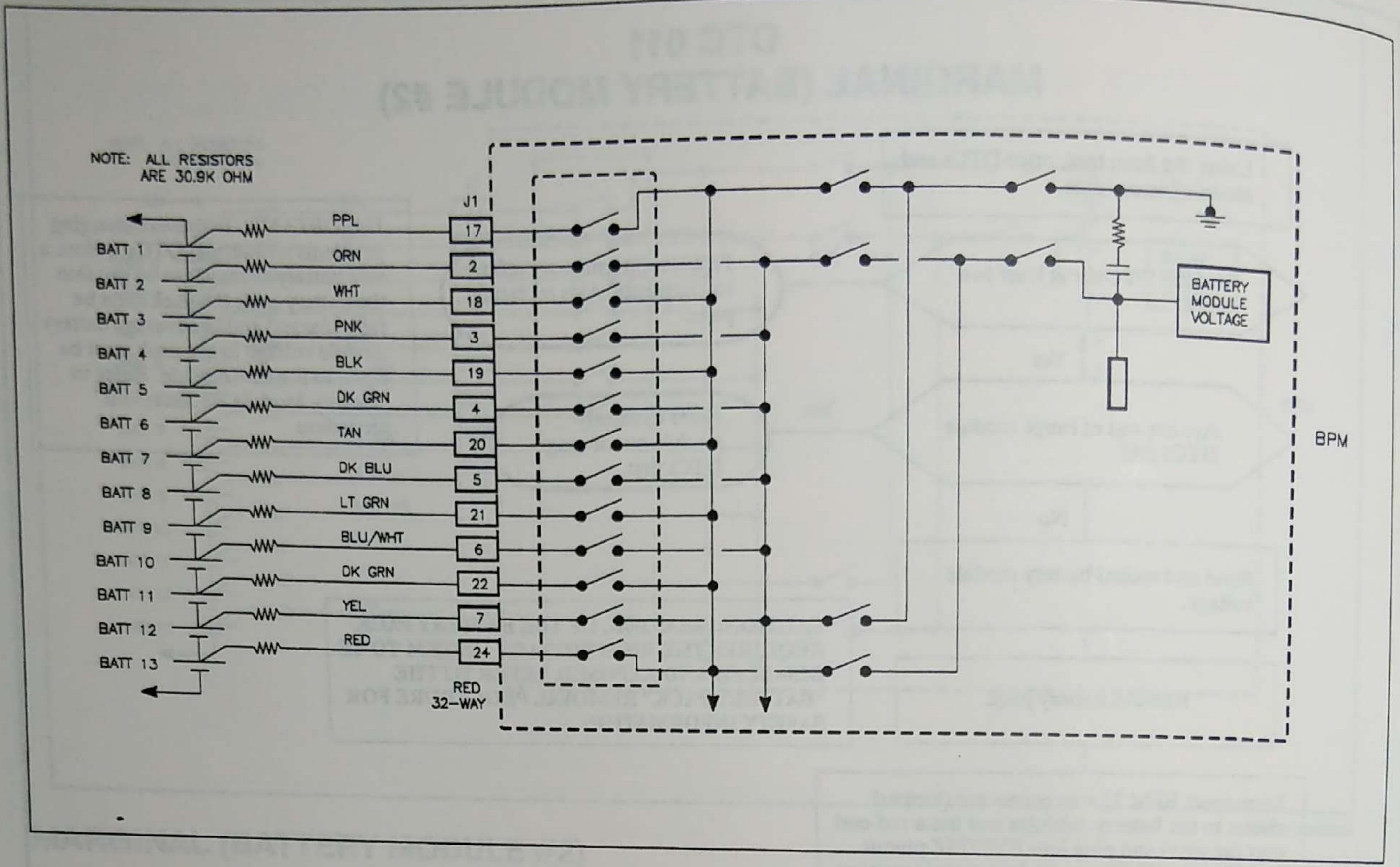

Using the Scan tool, print DTCs and module history data.
Has the DTC set at least two times?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any out of range module DTCs set?
Yes
Refer to battery module out of range DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Connections to battery module or battery module.
• Refer to battery module R and R procedure.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).
Is resistance approximately equal to 31K ohms?
Yes
Wire between BPM and battery cable sense lead.
No
Cable with sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 012 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #2)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is 0 to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #2 marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

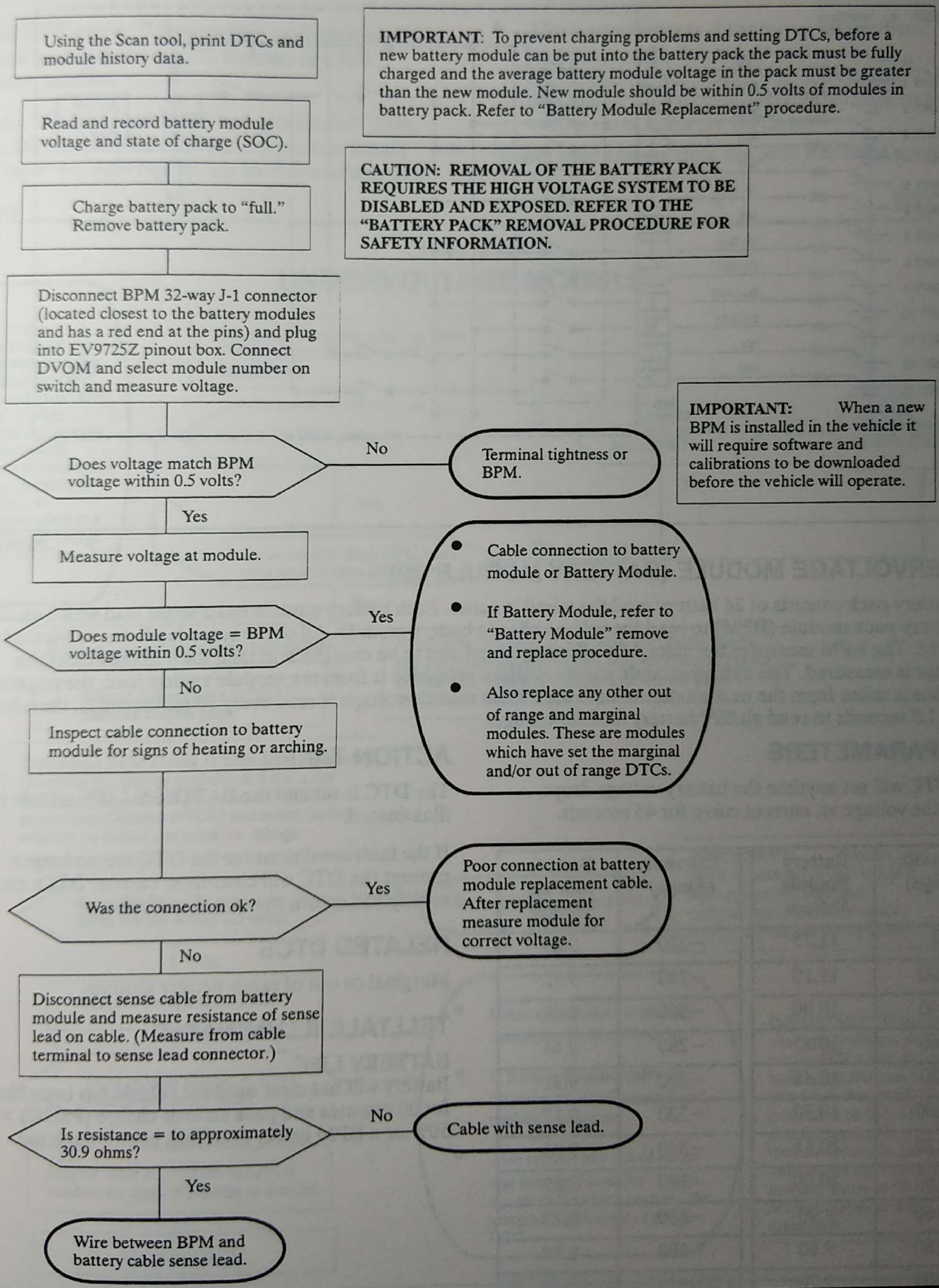
None

DIAGNOSTIC AIDS

- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

*Select Battery Module History from the Scan tool BPM menu.

DTC 012
OUT OF RANGE (BATTERY MODULE #2)



IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

Using the Scan tool, print DTCs and module history data.

Read and record battery module voltage and state of charge (SOC).

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Cable connection to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Poor connection at battery module replacement cable. After replacement measure module for correct voltage.

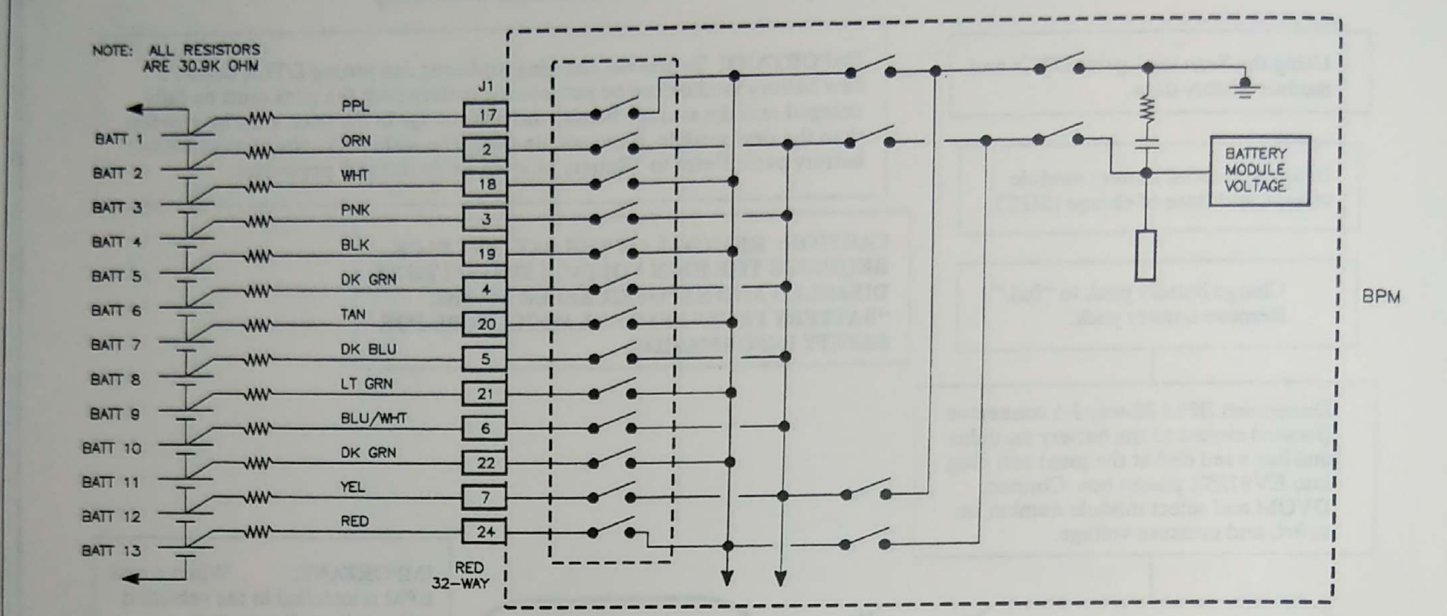
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)

Is resistance = to approximately 30.9 ohms?

Cable with sense lead.

Wire between BPM and battery cable sense lead.

DTC 013 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32–WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #2)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage	Current (Amps)	Battery Module Voltage
0	11.75	−220	9.60
−20	11.10	−240	9.52
−40	10.90	−260	9.48
−60	10.65	−280	9.44
−80	10.45	−300	9.31
−100	10.30	−320	9.17
−120	10.15	−340	9.03
−140	10.00	−360	8.87
−160	9.90	−380	8.73
−180	9.80	−400	8.59
−200	9.70		

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

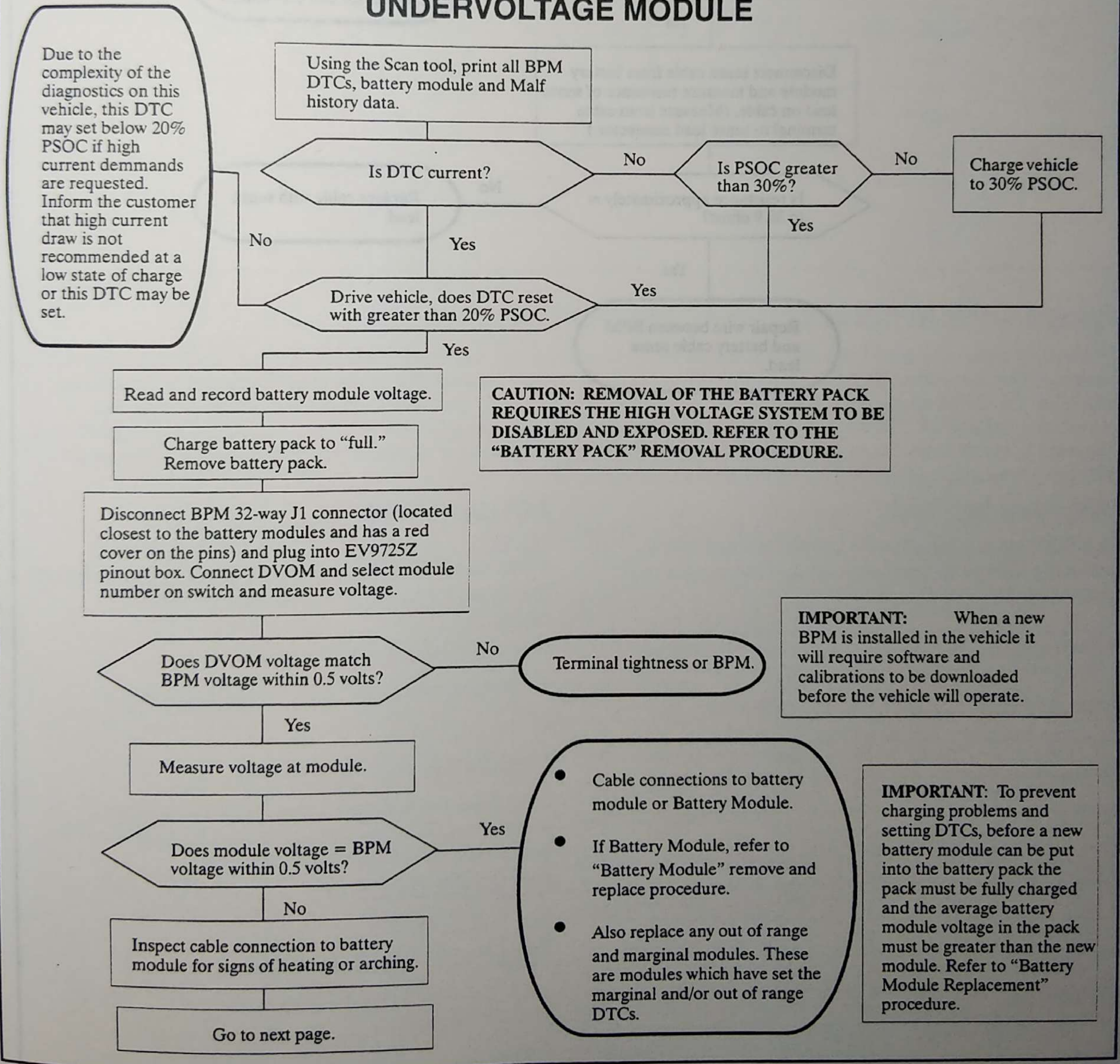
CS CamScanner

DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below 0% user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 013
UNDERVOLTAGE MODULE



Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

Using the Scan tool, print all BPM DTCs, battery module and Malf history data.

Is DTC current?

Is PSOC greater than 30%?

Charge vehicle to 30% PSOC.

Drive vehicle, does DTC reset with greater than 20% PSOC.

Read and record battery module voltage.

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

Inspect cable connection to battery module for signs of heating or arching.

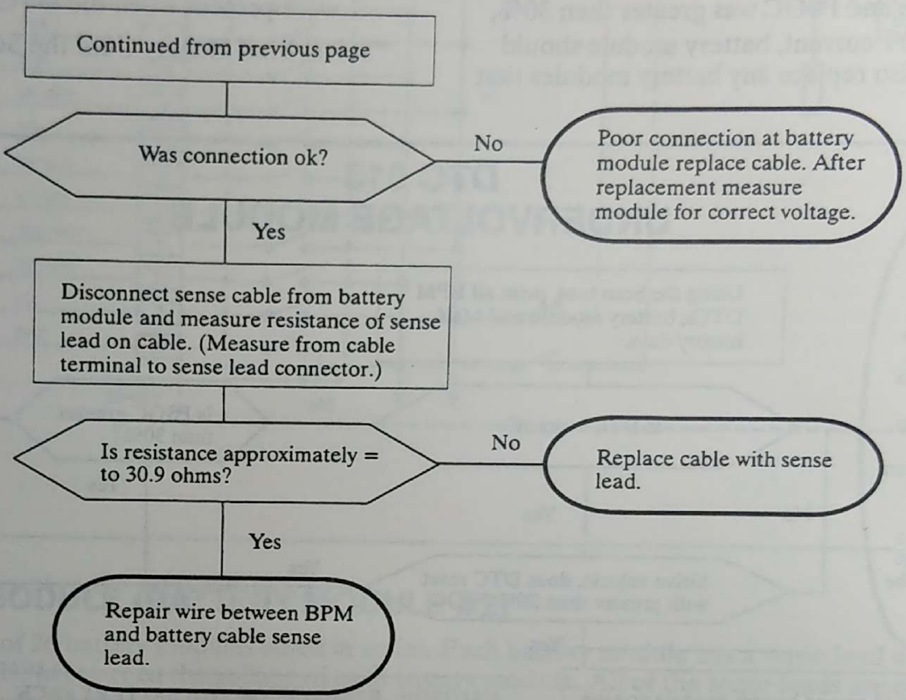
Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

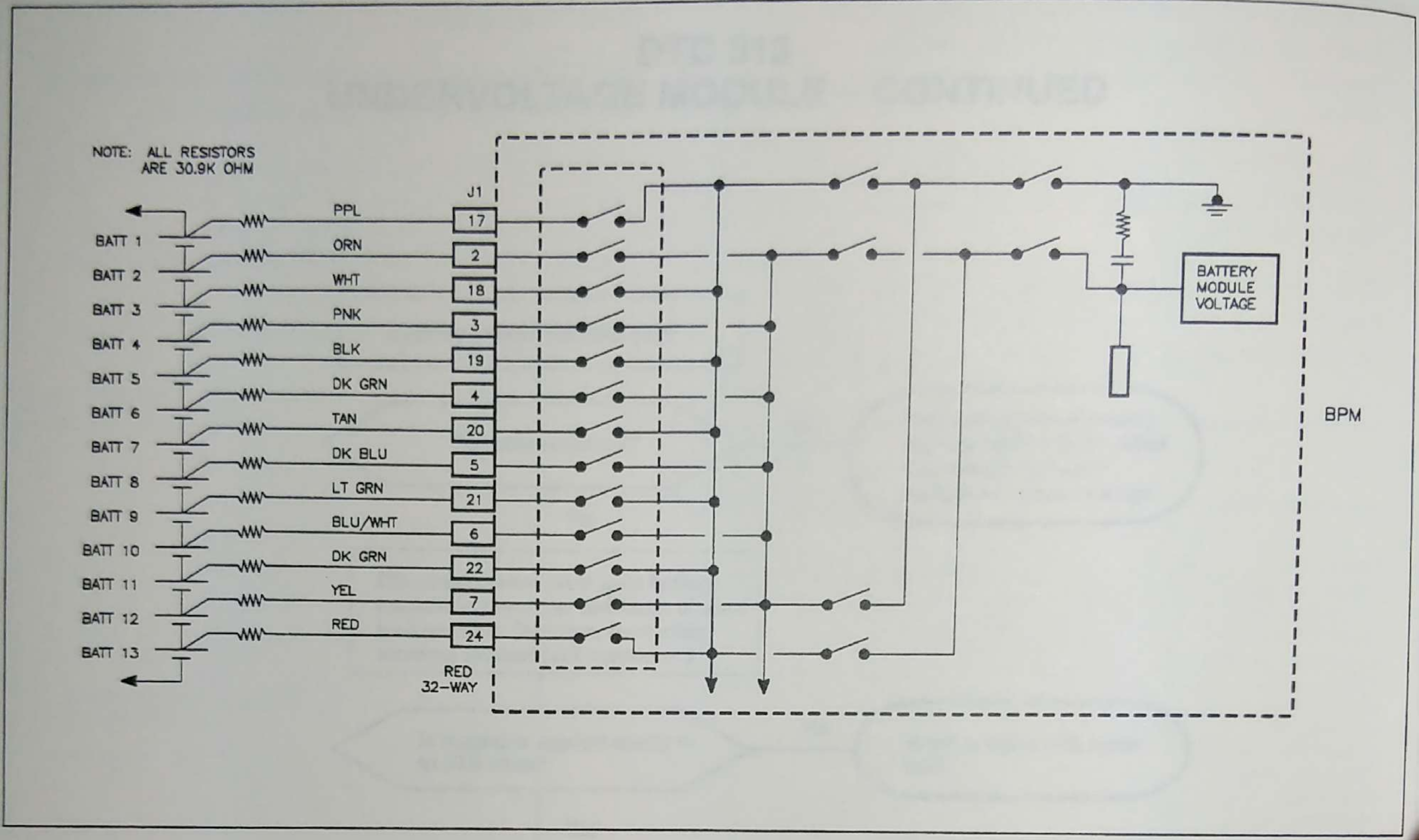
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 013
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 014 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
J1
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #2)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

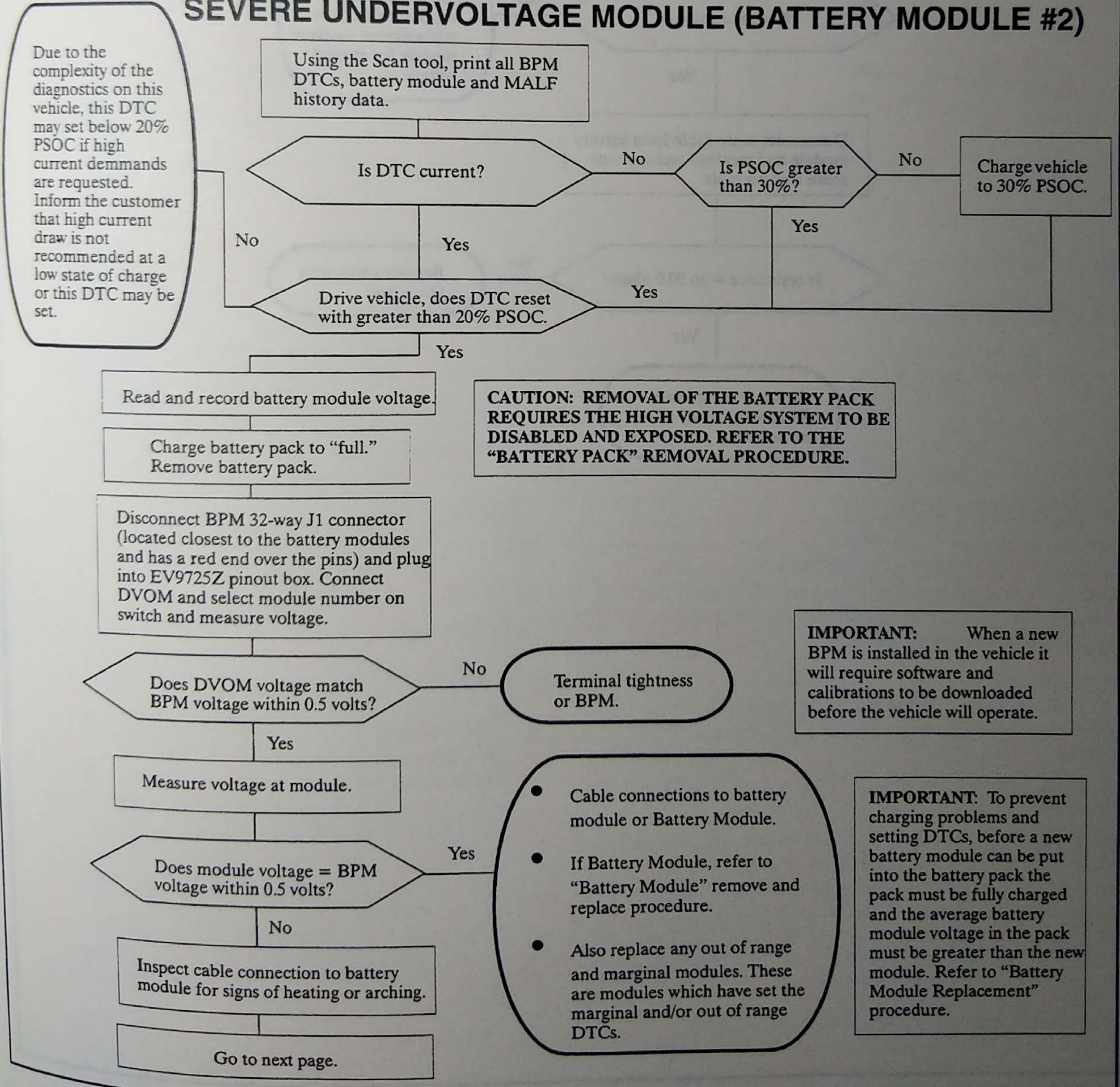
Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches 0% user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 014
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #2)



Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

Using the Scan tool, print all BPM DTCs, battery module and MALF history data.

Is DTC current?

Is PSOC greater than 30%?

Charge vehicle to 30% PSOC.

Drive vehicle, does DTC reset with greater than 20% PSOC.

Read and record battery module voltage.

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

Inspect cable connection to battery module for signs of heating or arching.

Go to next page.

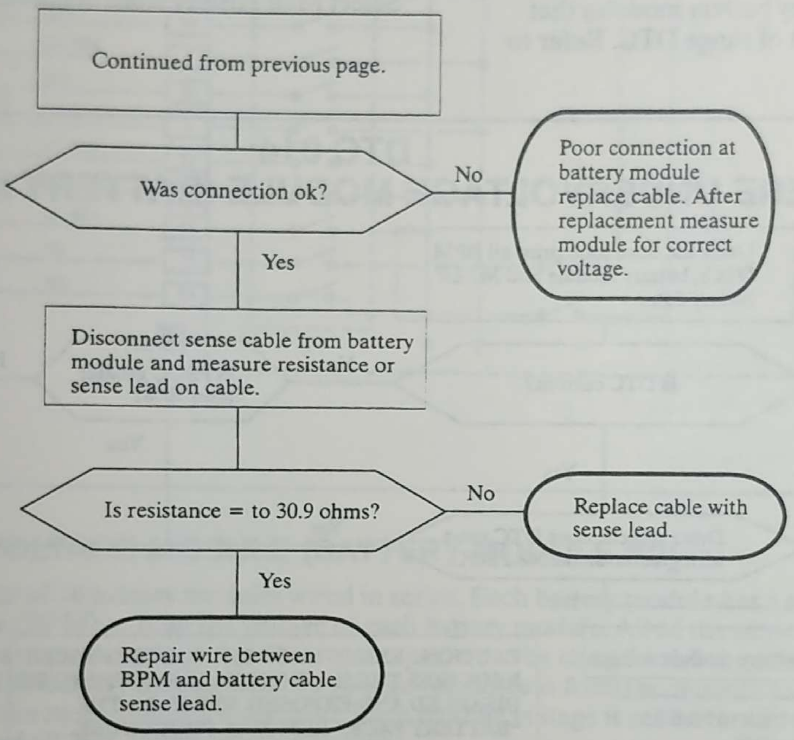
- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

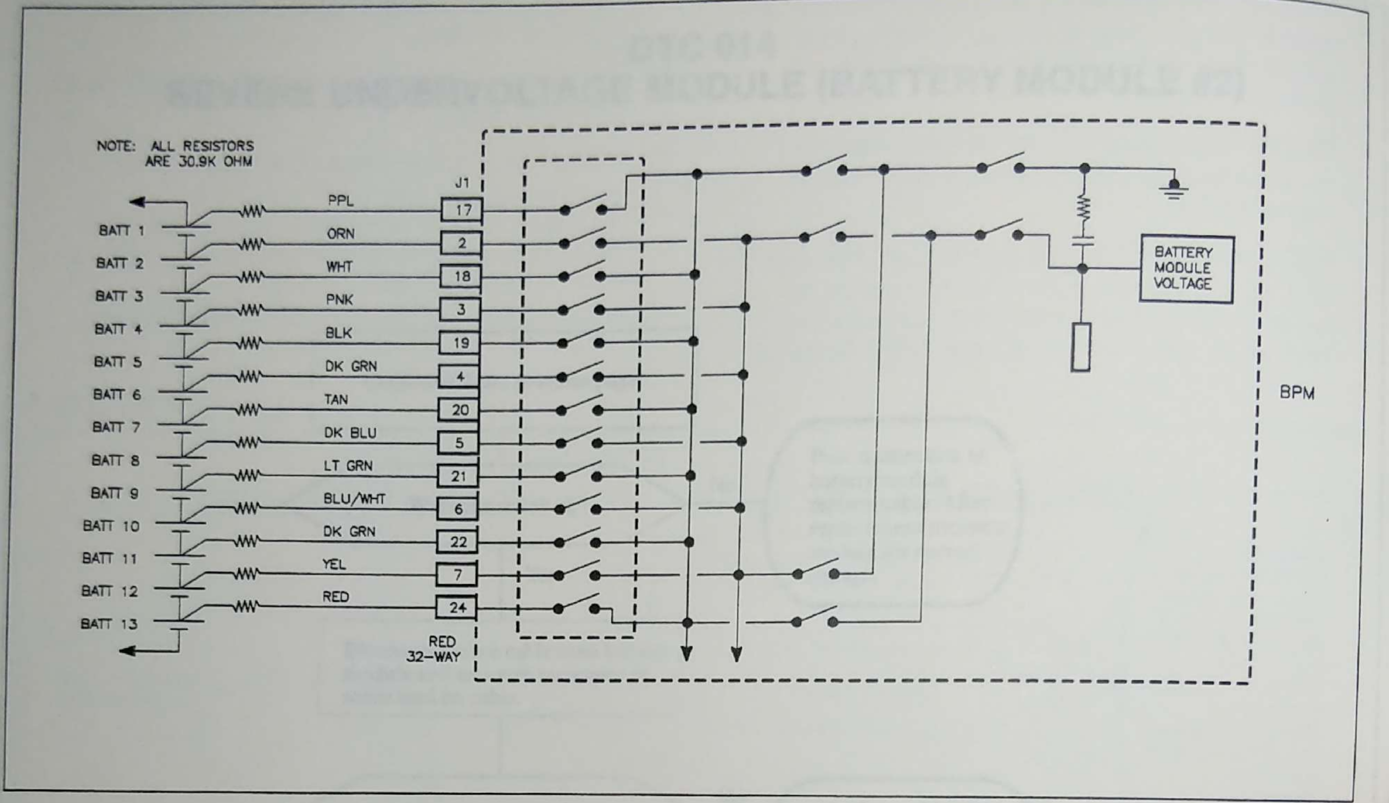
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 014
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #2)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 015 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #2)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

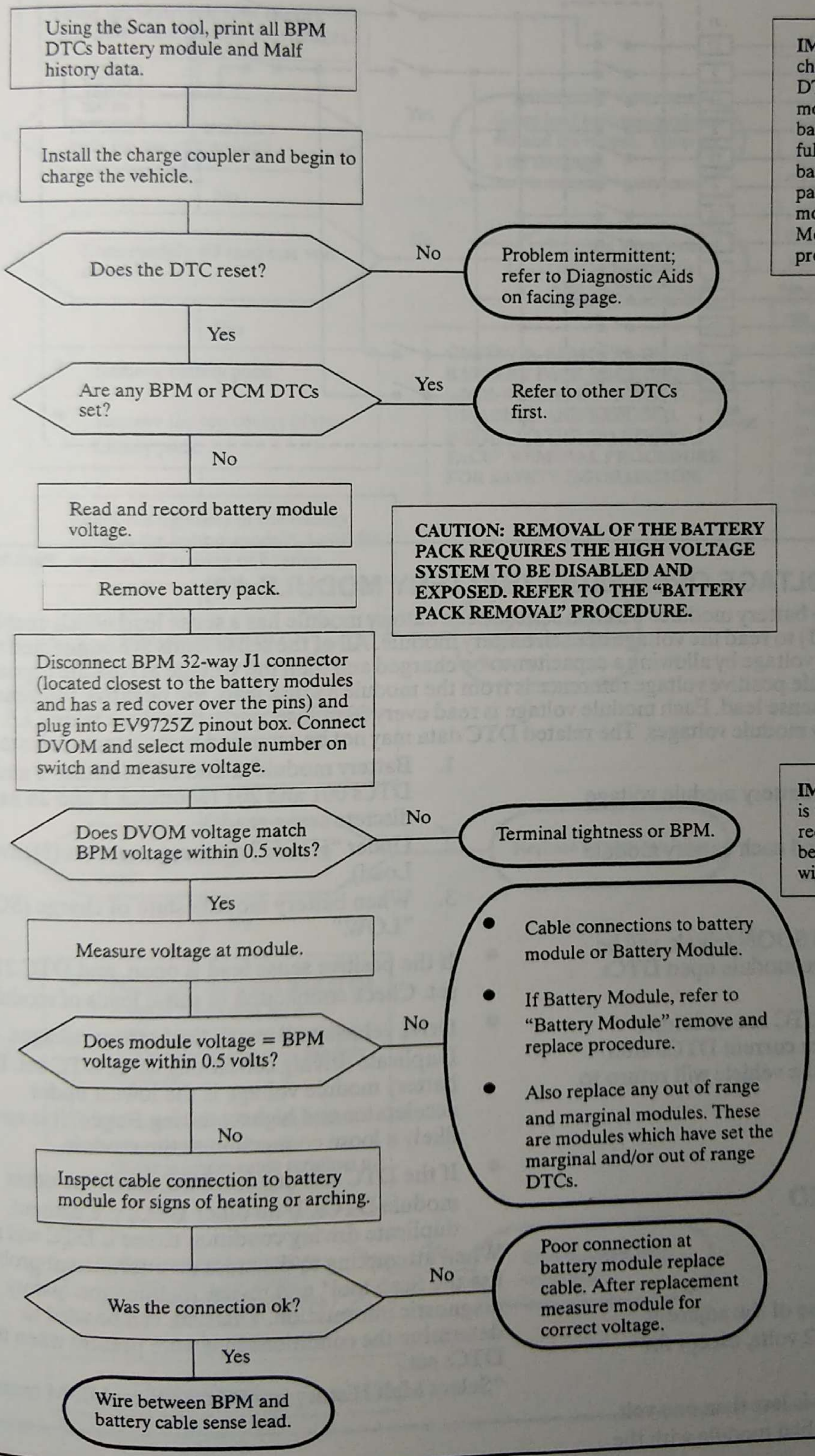
SERVICE NOW and REDUCED PERFORMANCE

DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

DTC 015
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #2)


Using the Scan tool, print all BPM DTCs battery module and Malf history data.
Install the charge coupler and begin to charge the vehicle.
Does the DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any BPM or PCM DTCs set?
Yes
Refer to other DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
No
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Wire between BPM and battery cable sense lead.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

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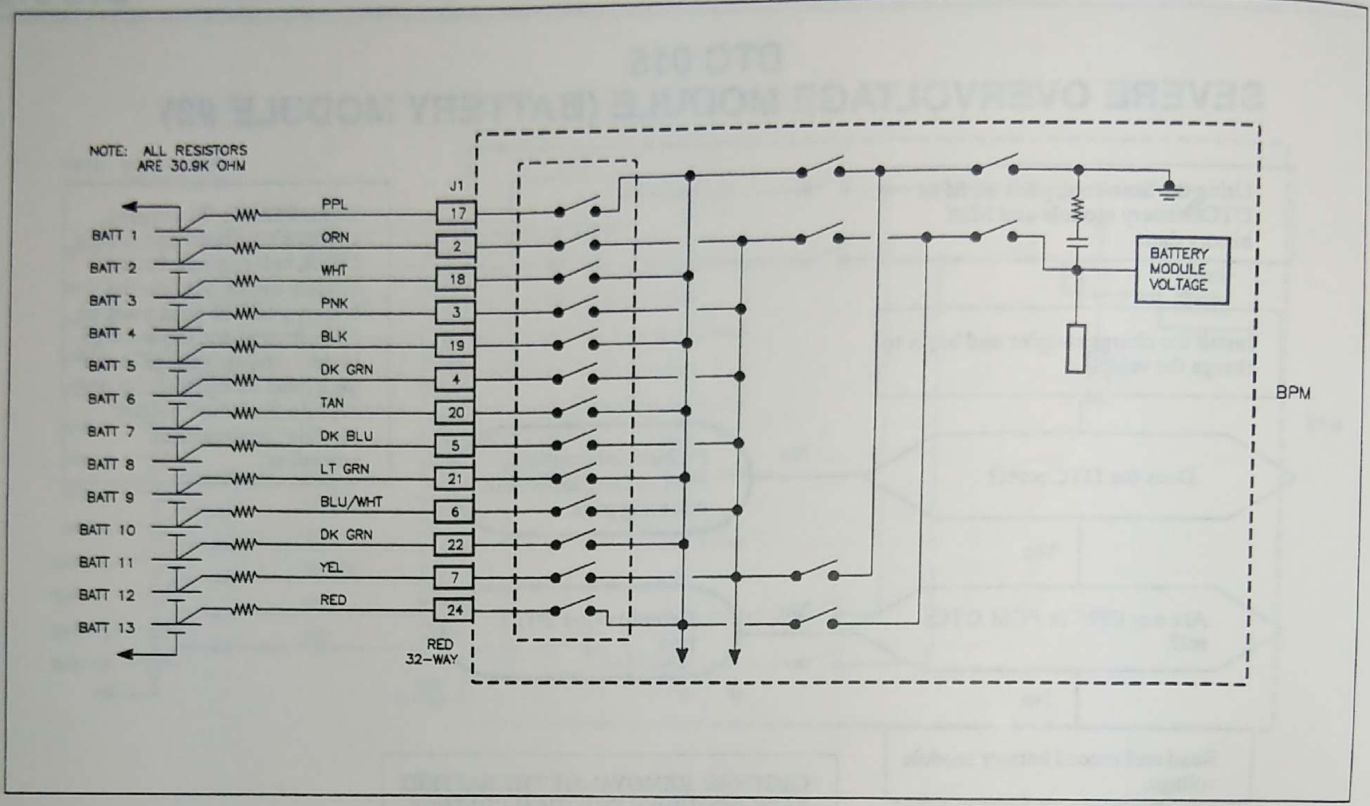
DTC 017 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #3)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:

1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
2. Under "HIGH" discharge current (Heavy Load).
3. When battery module state of charge (SOC) is "LOW."

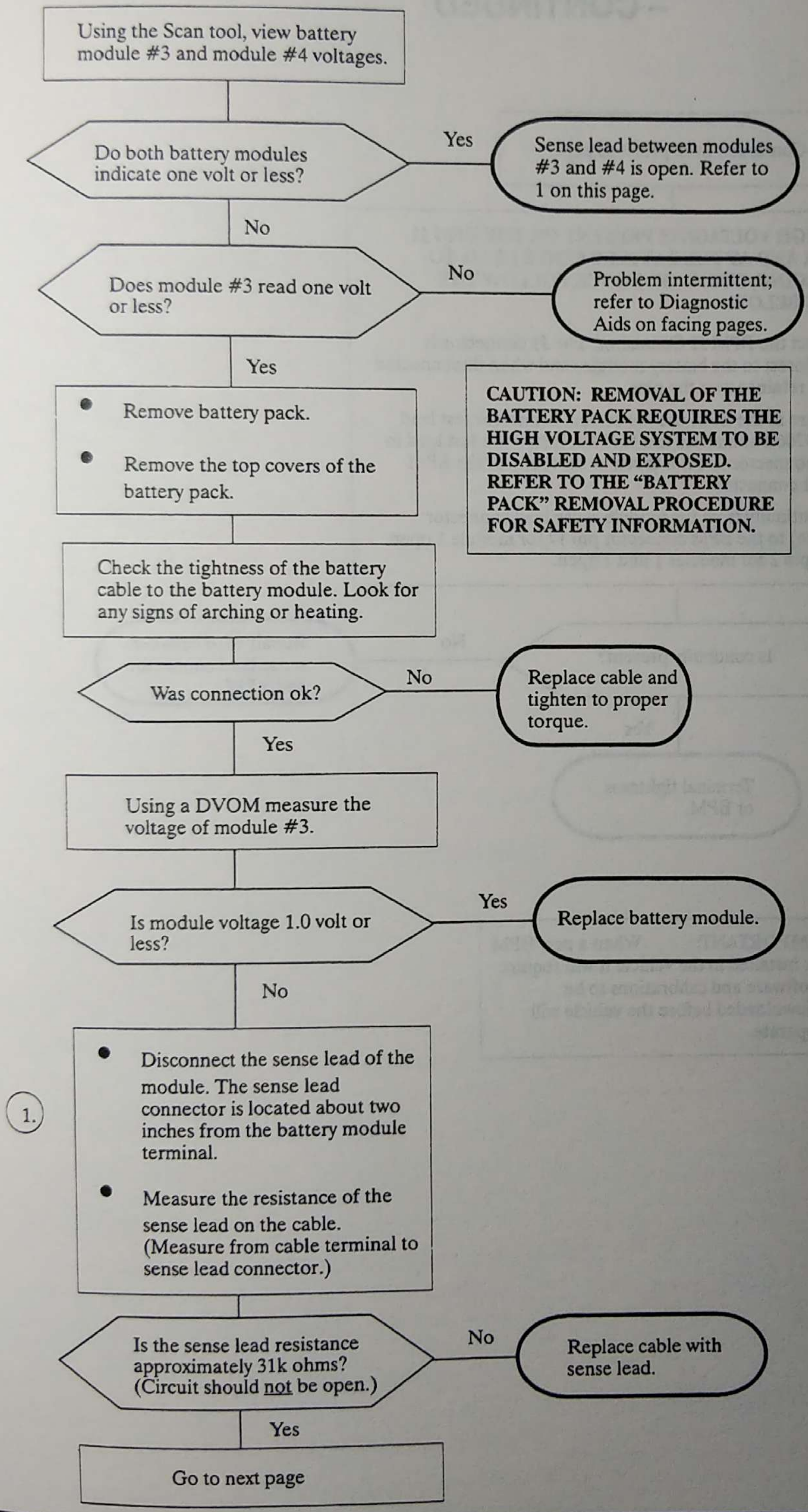
- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

CS CamScanner

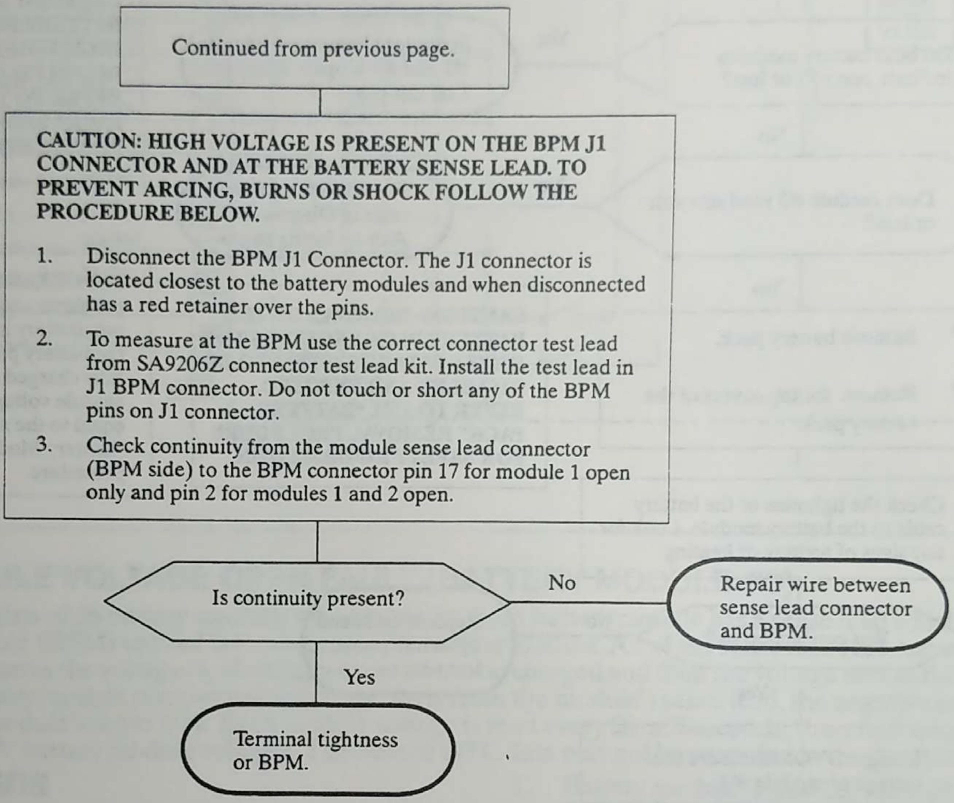
DTC 017
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #3)


Using the Scan tool, view battery module #3 and module #4 voltages.
Do both battery modules indicate one volt or less?
Yes
Sense lead between modules #3 and #4 is open. Refer to 1 on this page.
No
Does module #3 read one volt or less?
No
Problem intermittent; refer to Diagnostic Aids on facing pages.
Yes
Remove battery pack.
Remove the top covers of the battery pack.
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.
Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.
Was connection ok?
No
Replace cable and tighten to proper torque.
Yes
Using a DVOM measure the voltage of module #3.
Is module voltage 1.0 volt or less?
Yes
Replace battery module.
No
1.
Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)
Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)
No
Replace cable with sense lead.
Yes
Go to next page

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 017
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #3) – CONTINUED



Continued from previous page.

CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

Is continuity present?

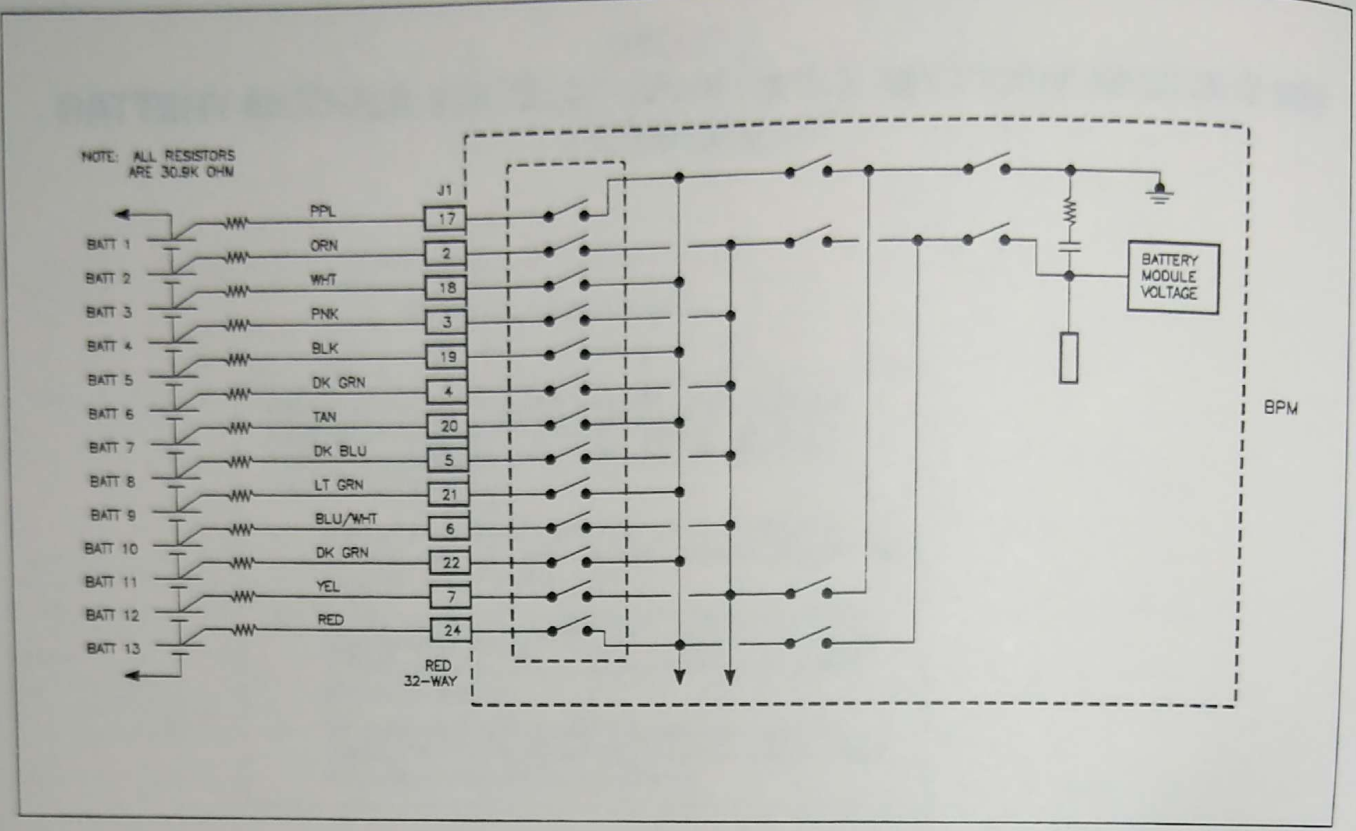
No: Repair wire between sense lead connector and BPM.

Yes: Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 019 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #3)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is 0 to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #3: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

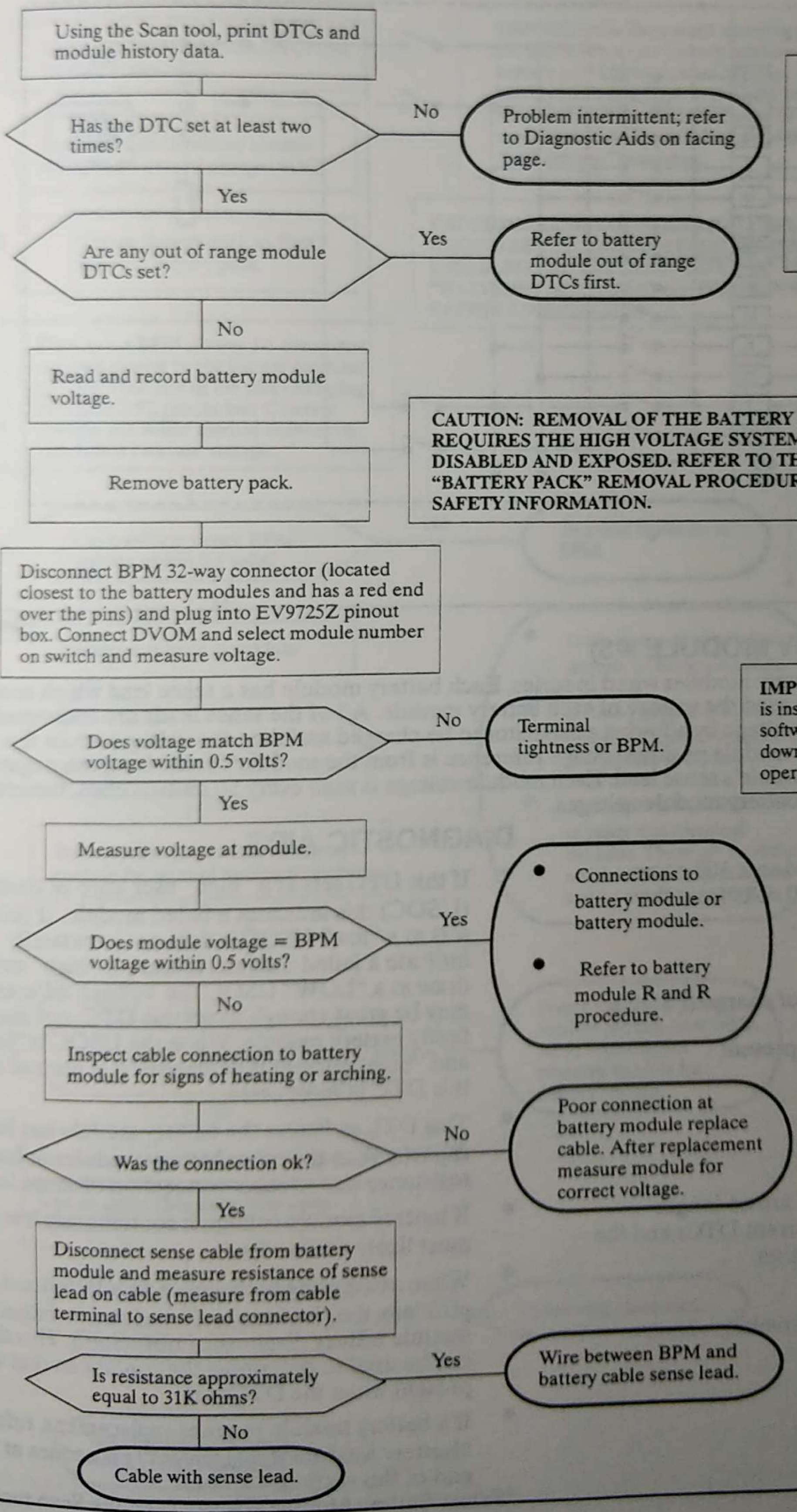
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section..
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

DTC 019
MARGINAL (BATTERY MODULE #3)

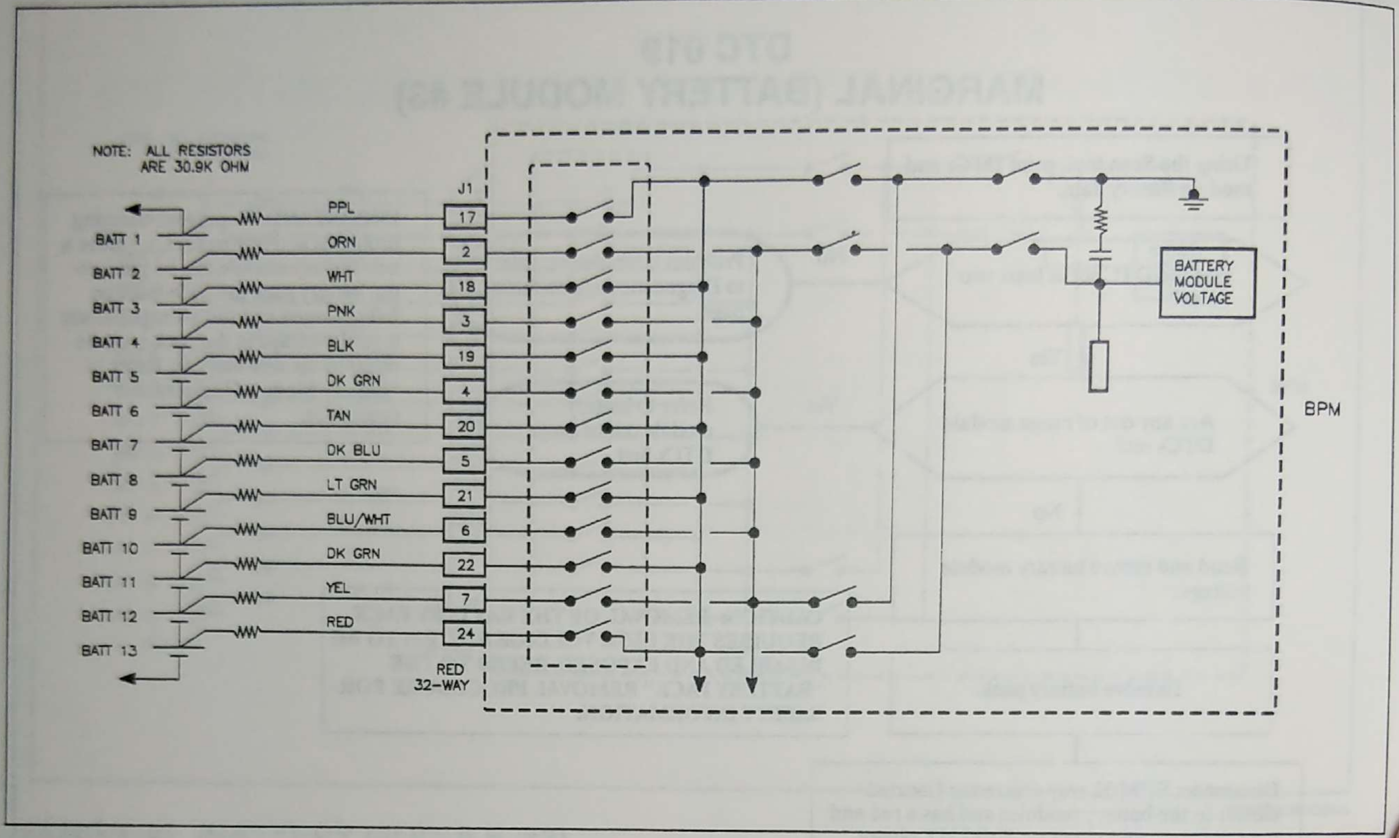

Using the Scan tool, print DTCs and module history data.
Has the DTC set at least two times?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any out of range module DTCs set?
Yes
Refer to battery module out of range DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Connections to battery module or battery module.
• Refer to battery module R and R procedure.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).
Is resistance approximately equal to 31K ohms?
Yes
Wire between BPM and battery cable sense lead.
No
Cable with sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 020 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #3)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is 0 to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #3: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

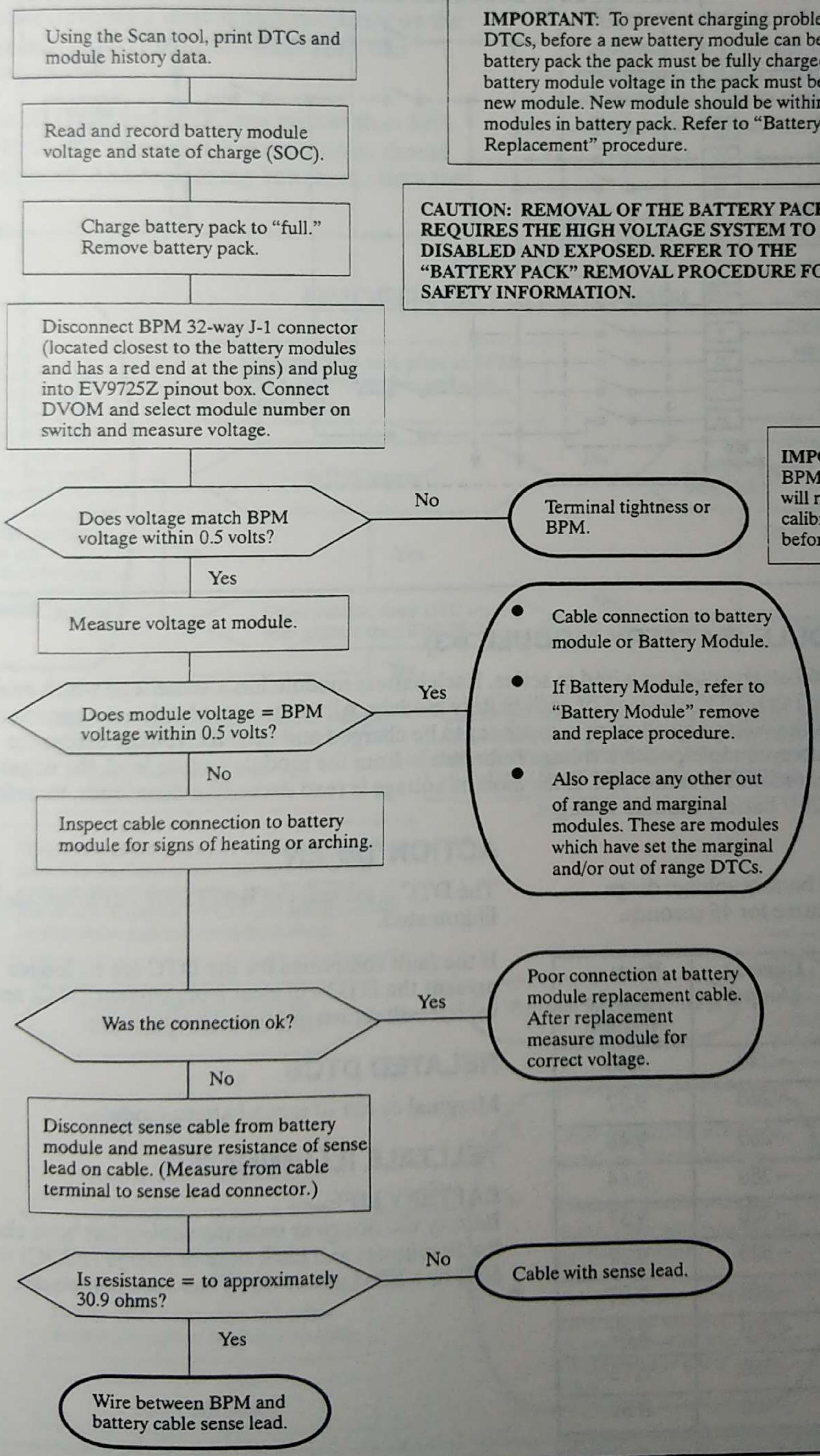
- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

*Select Battery Module History from the Scan tool BPM menu.

DTC 020
OUT OF RANGE (BATTERY MODULE #3)

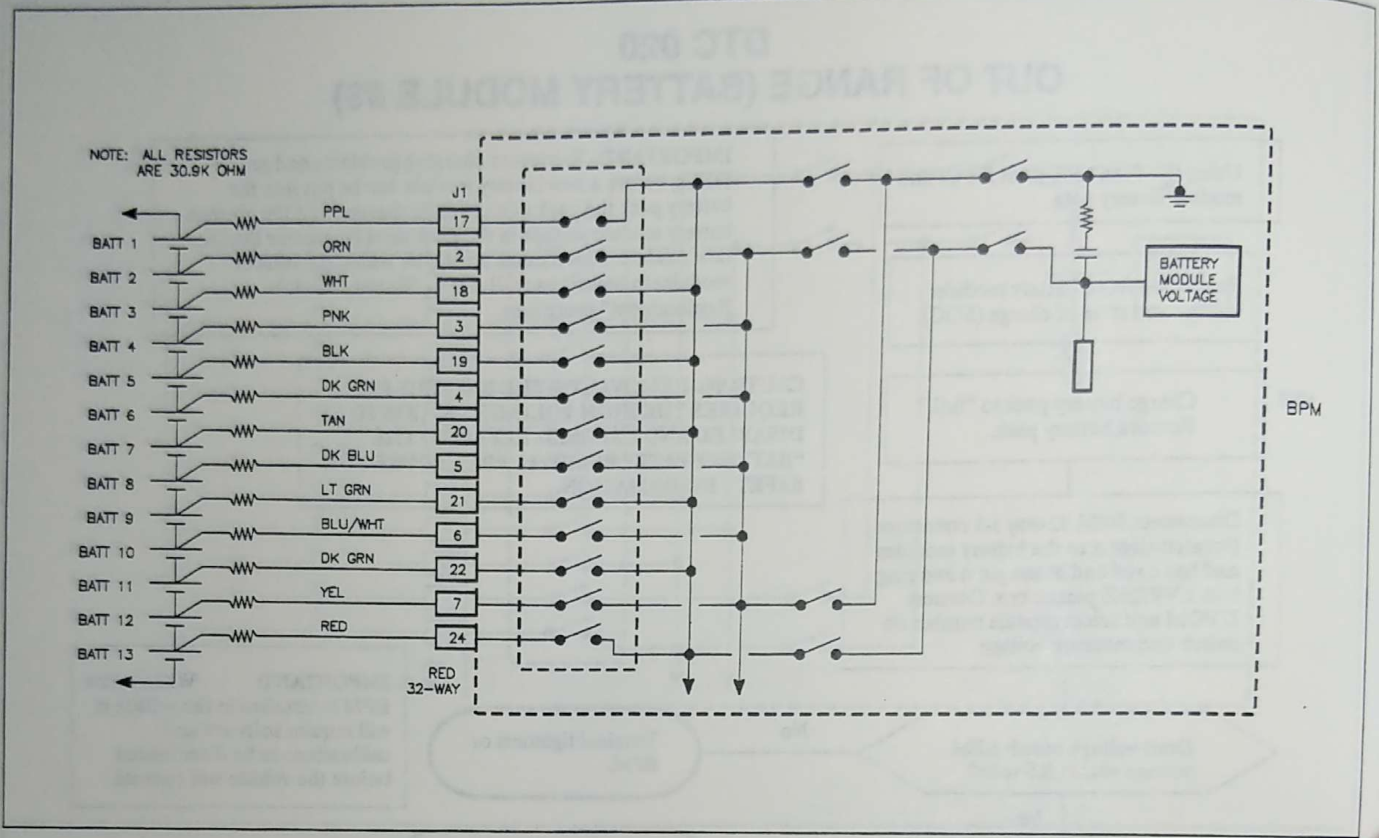
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.


Using the Scan tool, print DTCs and module history data.
Read and record battery module voltage and state of charge (SOC).
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Cable connection to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
Yes
Poor connection at battery module replacement cable. After replacement measure module for correct voltage.
No
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance = to approximately 30.9 ohms?
No
Cable with sense lead.
Yes
Wire between BPM and battery cable sense lead.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 021 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #3)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage	Current (Amps)	Battery Module Voltage
0	11.75	−220	9.60
−20	11.10	−240	9.52
−40	10.90	−260	9.48
−60	10.65	−280	9.44
−80	10.45	−300	9.31
−100	10.30	−320	9.17
−120	10.15	−340	9.03
−140	10.00	−360	8.87
−160	9.90	−380	8.73
−180	9.80	−400	8.59
−200	9.70		

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

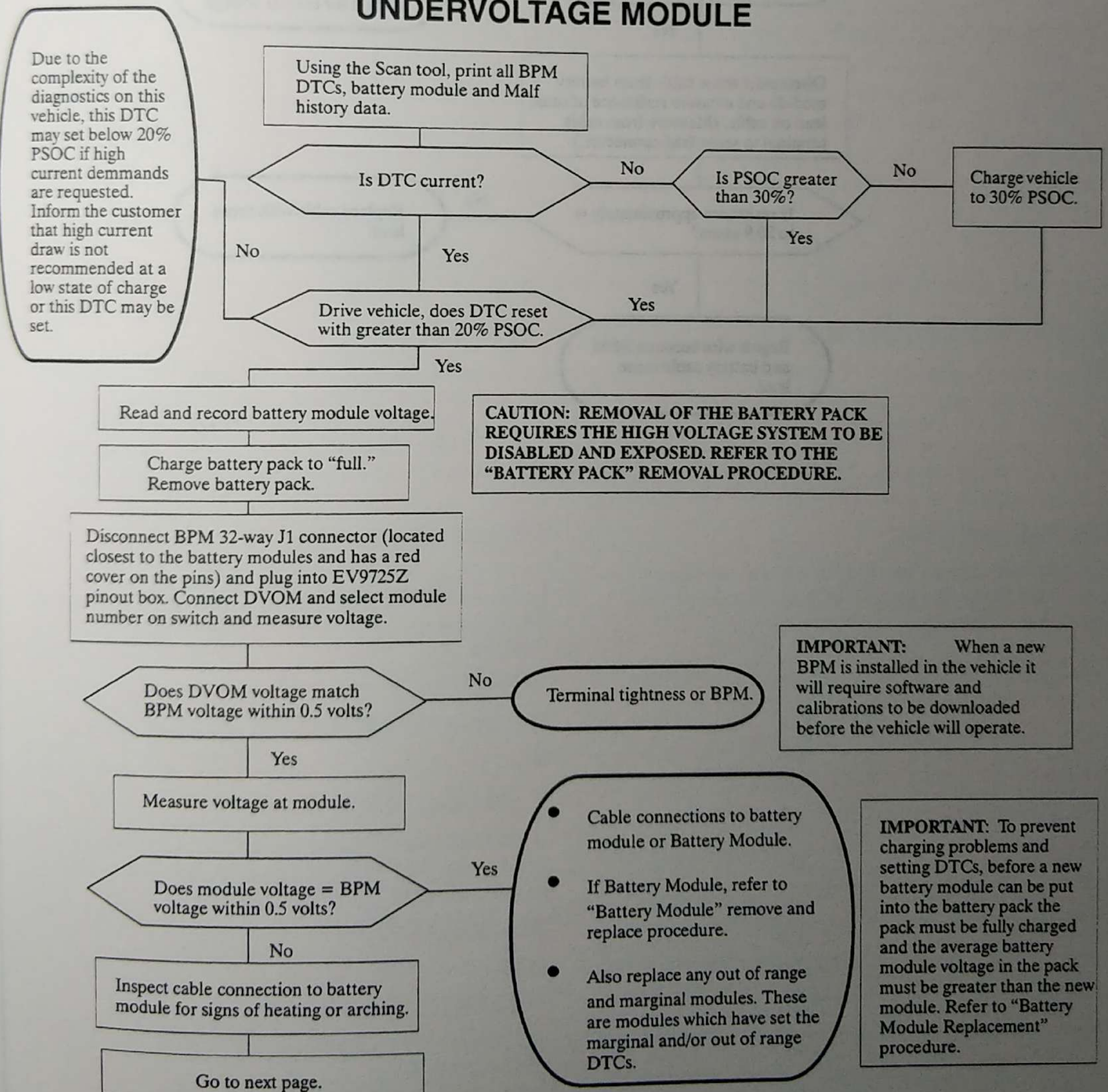
DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below 0% user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 021

DTC 021
UNDERVOLTAGE MODULE

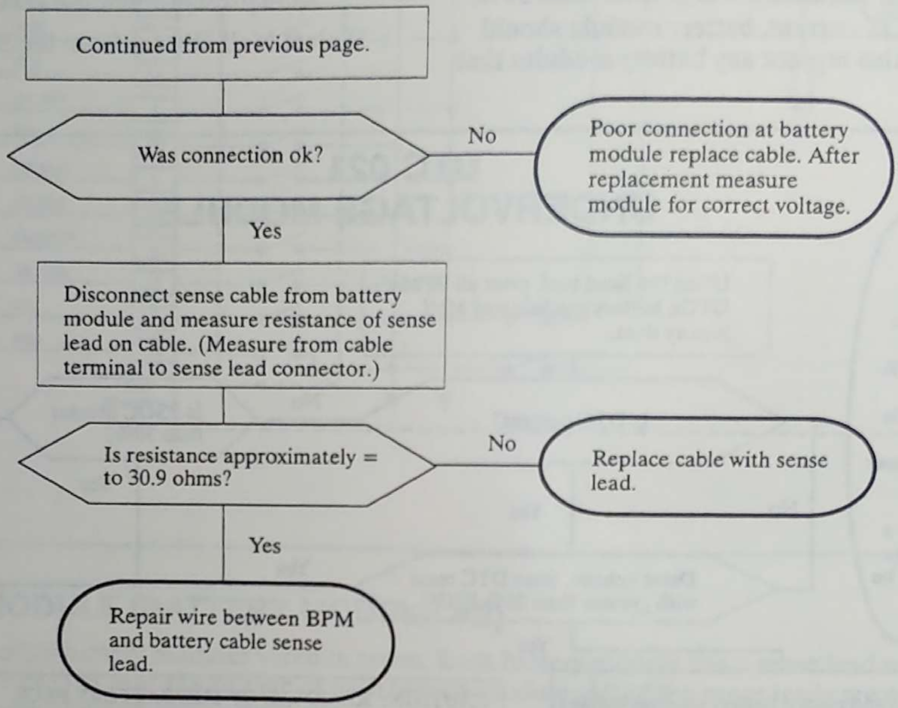

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

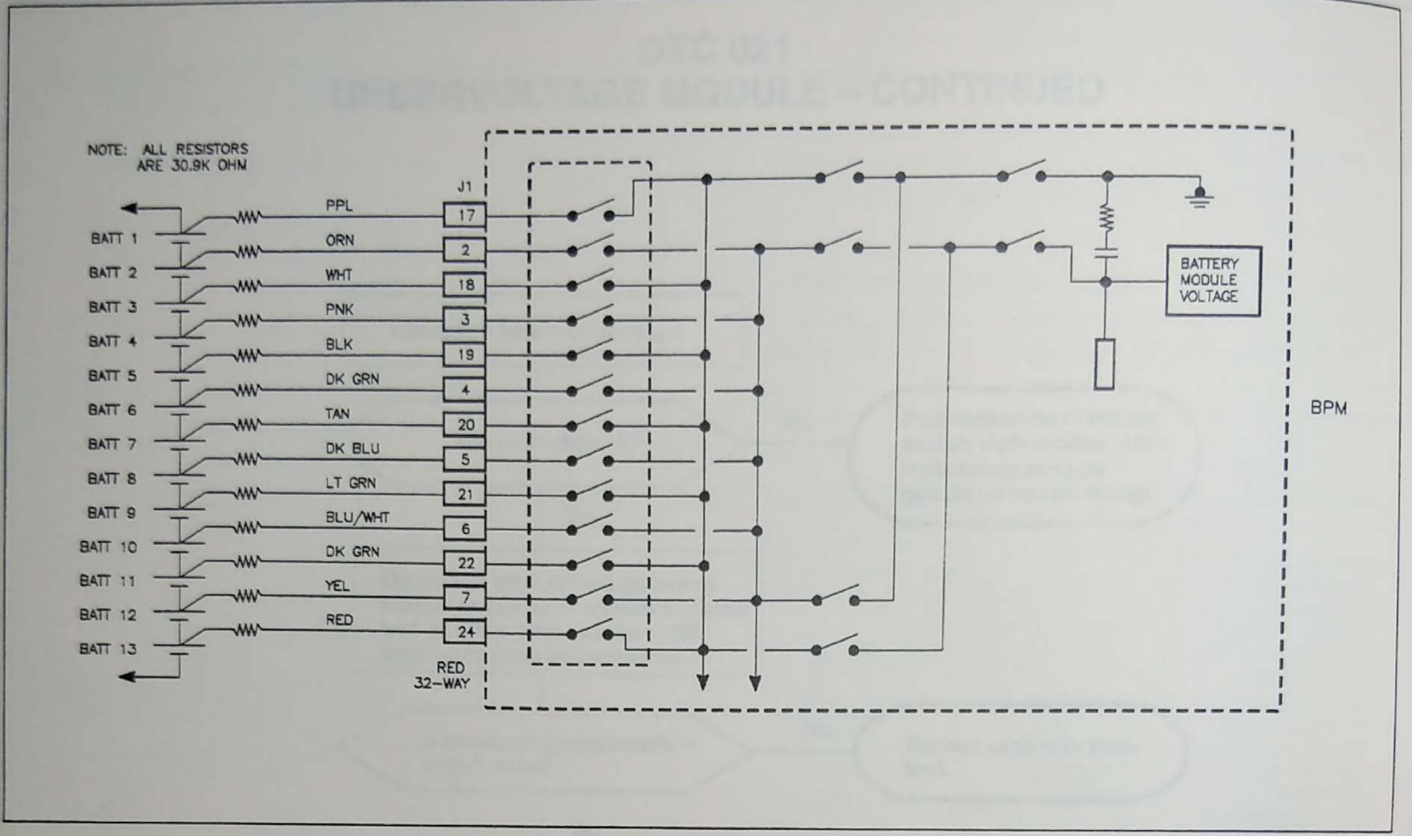
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 021
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 022 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
J1
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #3)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage
0	11.45
-20	10.55
-40	10.20
-60	9.95
-80	9.75
-100	9.60
-120	9.45
-140	9.30
-160	9.20
-180	9.10
-200	9.00
-220	8.90
-240	8.82
-260	8.78
-280	8.74
-300	8.70
-320	8.66
-340	8.58
-360	8.43
-380	8.28
-400	8.14

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

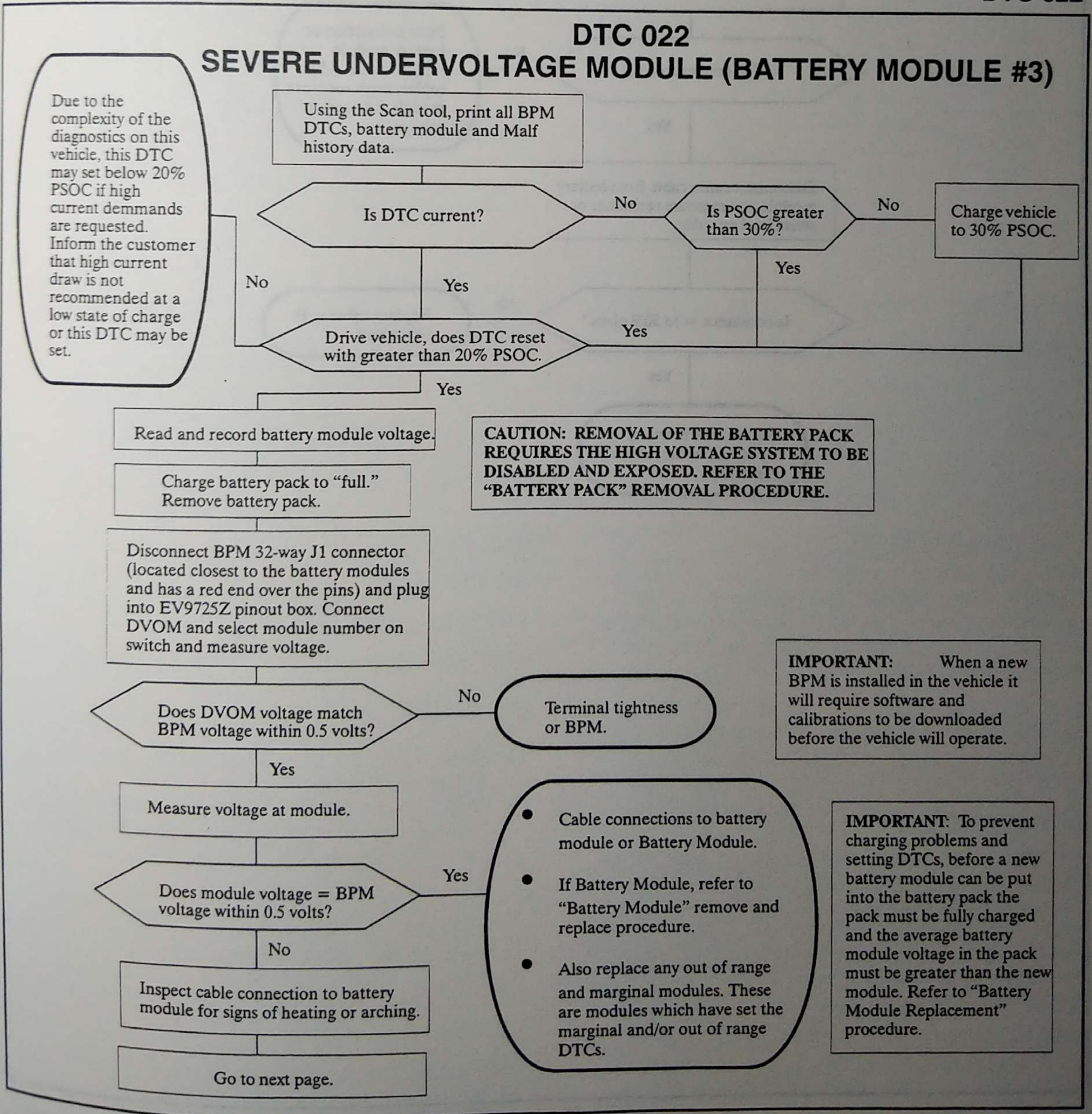
Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches 0% user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 022
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #3)


Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
Yes
No
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

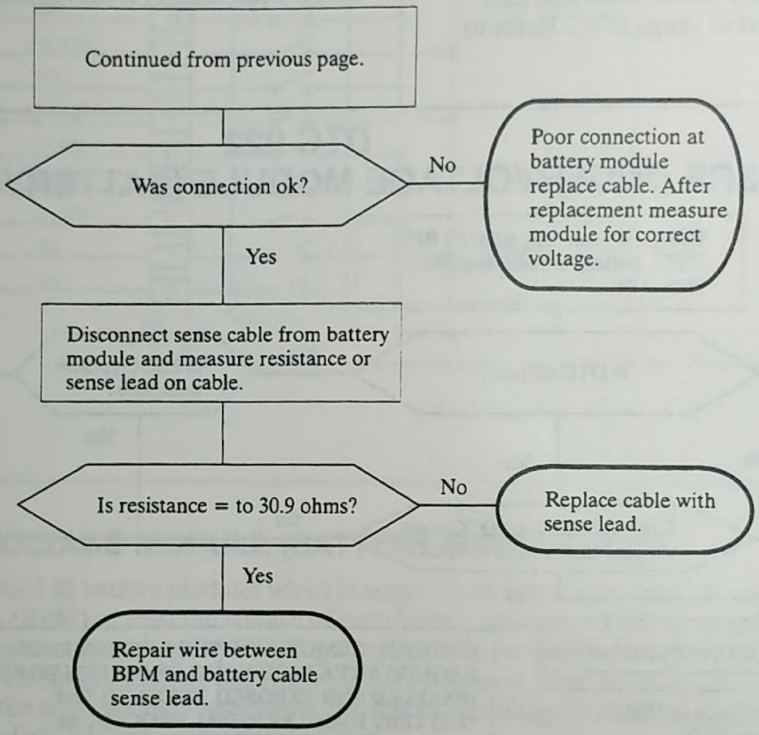
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

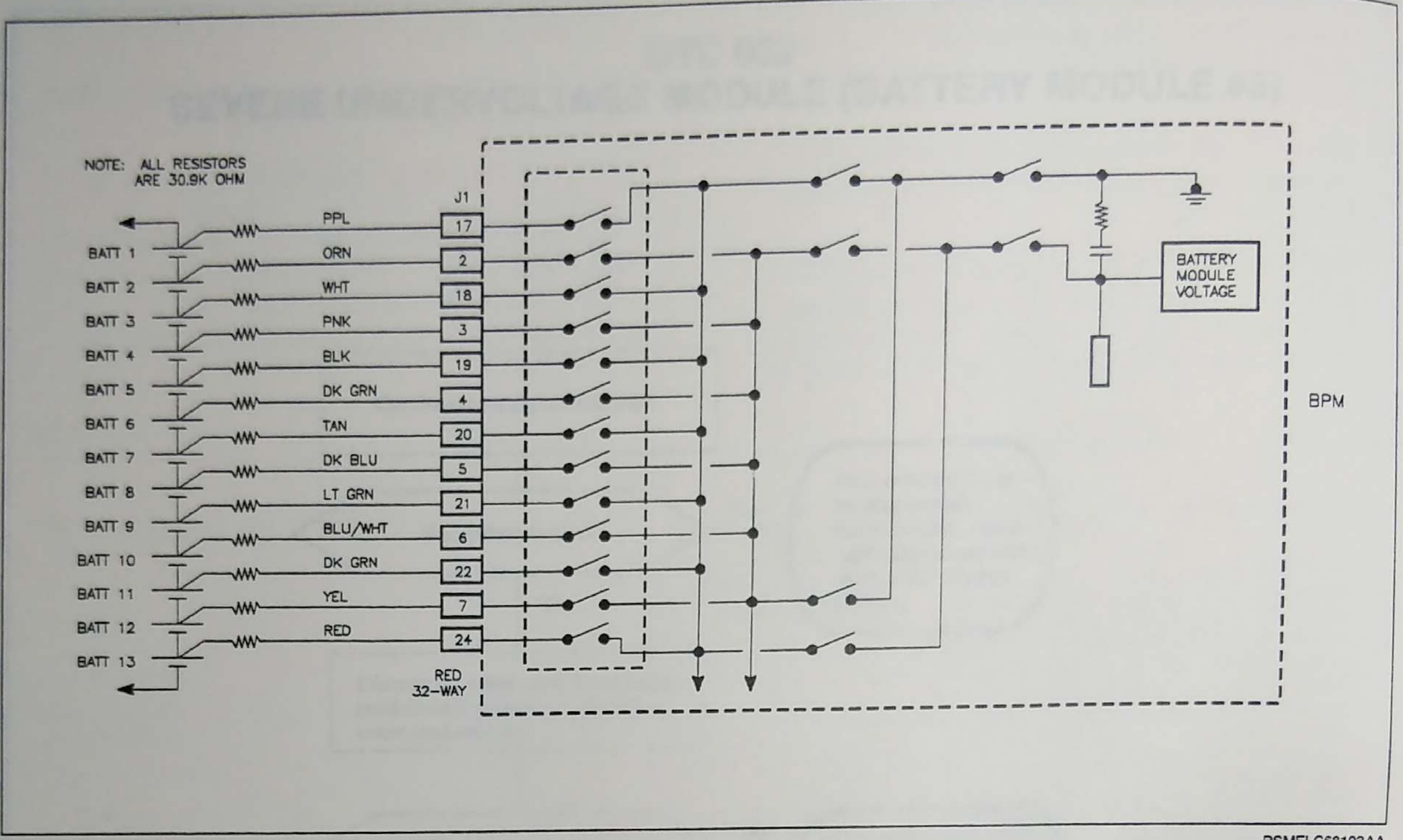
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 022
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #3)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 023 – SEVERE OVERVOLTAGE MODULE


NOTE: ALL RESISTORS
ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED
32-WAY
BATTERY
MODULE
VOLTAGE
BPM
PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #3)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

SERVICE NOW and REDUCED PERFORMANCE

DIAGNOSTIC AIDS

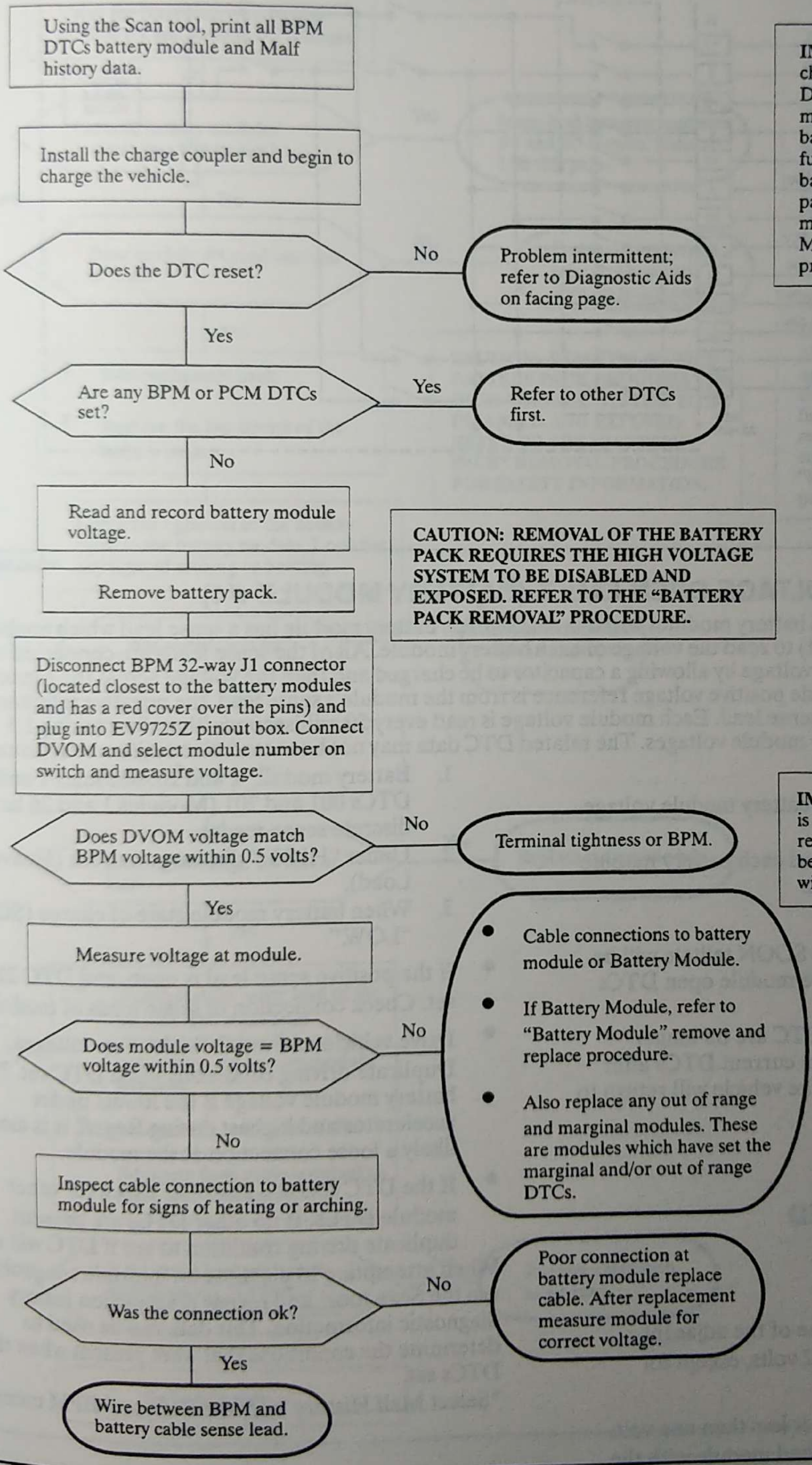
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

CS CamScanner

DTC 023
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #3)



Using the Scan tool, print all BPM DTCs battery module and Malf history data.

Install the charge coupler and begin to charge the vehicle.

Does the DTC reset?

No: Problem intermittent; refer to Diagnostic Aids on facing page.

Yes: Are any BPM or PCM DTCs set?

Yes: Refer to other DTCs first.

No: Read and record battery module voltage.

Remove battery pack.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

No: Terminal tightness or BPM.

Yes: Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

No:

- Cable connections to battery module or Battery Module.
- If Battery Module, refer to “Battery Module” remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

No: Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

No: Poor connection at battery module replace cable. After replacement measure module for correct voltage.

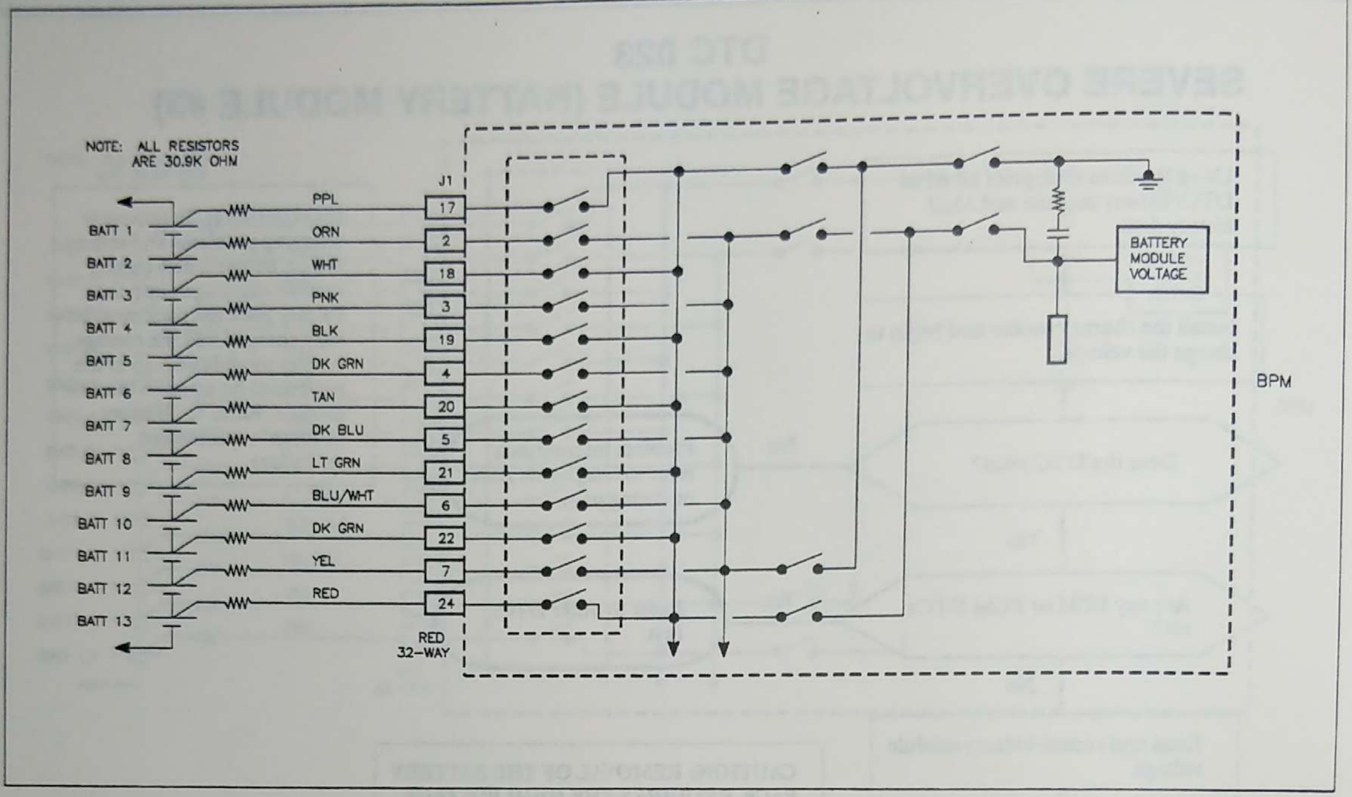
Yes: Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to “Battery Module” replacement procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE “BATTERY PACK REMOVAL” PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 025 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #4)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:

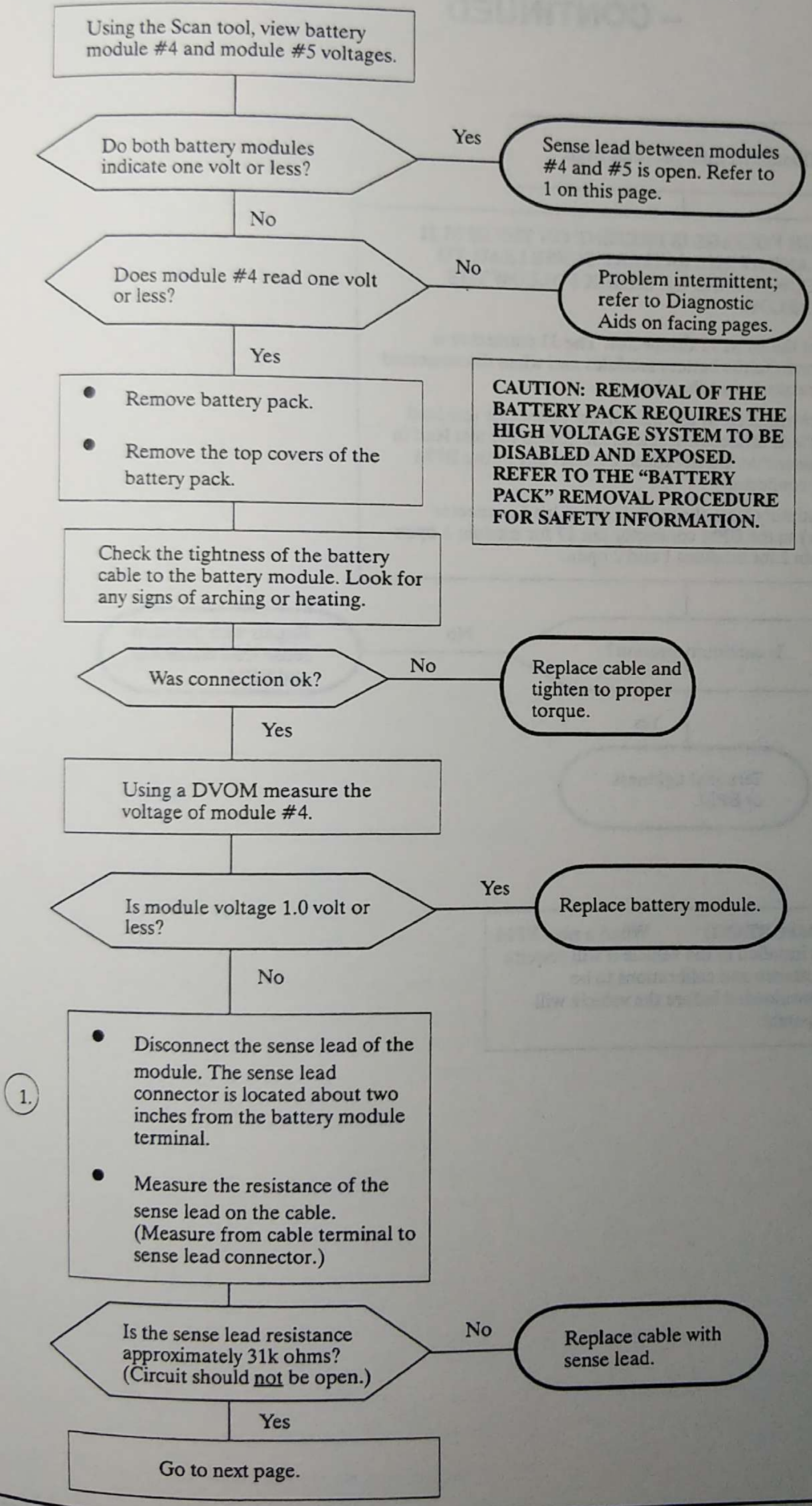
1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
2. Under "HIGH" discharge current (Heavy Load).
3. When battery module state of charge (SOC) is "LOW."

- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 025
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #4)

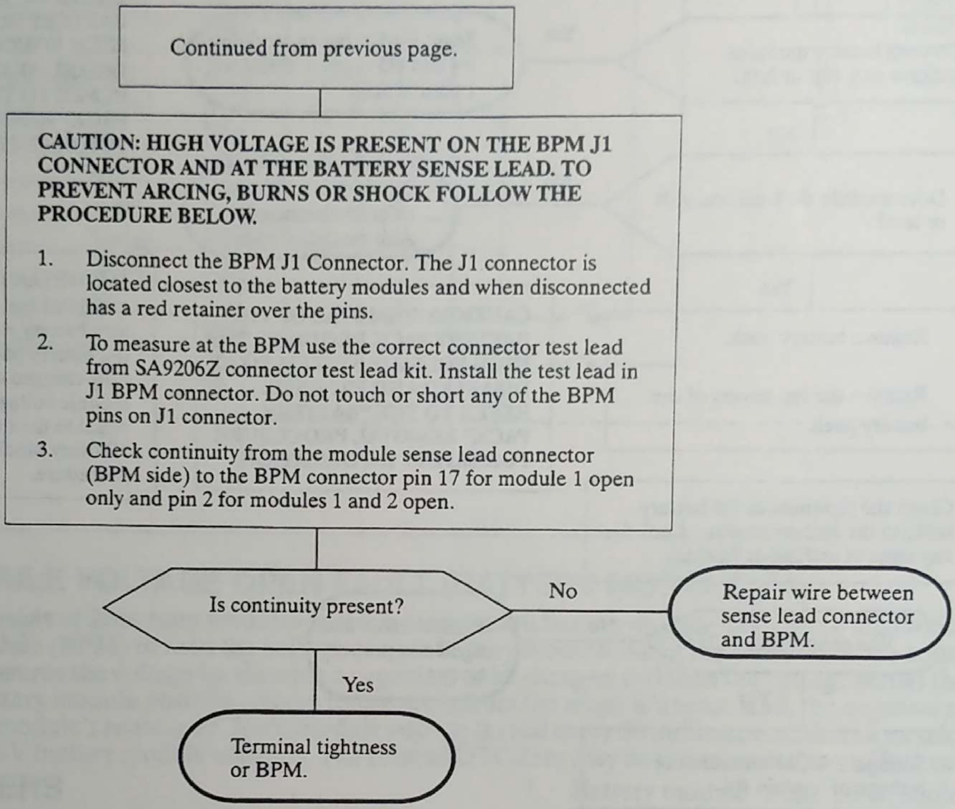

Using the Scan tool, view battery module #4 and module #5 voltages.
Do both battery modules indicate one volt or less?
Yes
Sense lead between modules #4 and #5 is open. Refer to 1 on this page.
No
Does module #4 read one volt or less?
No
Problem intermittent; refer to Diagnostic Aids on facing pages.
Yes
• Remove battery pack.
• Remove the top covers of the battery pack.
Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.
Was connection ok?
No
Replace cable and tighten to proper torque.
Yes
Using a DVOM measure the voltage of module #4.
Is module voltage 1.0 volt or less?
Yes
Replace battery module.
No
1.
• Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
• Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)
Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)
No
Replace cable with sense lead.
Yes
Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 025
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #4) – CONTINUED


Continued from previous page.
Is continuity present?
No
Repair wire between sense lead connector and BPM.
Yes
Terminal tightness or BPM.

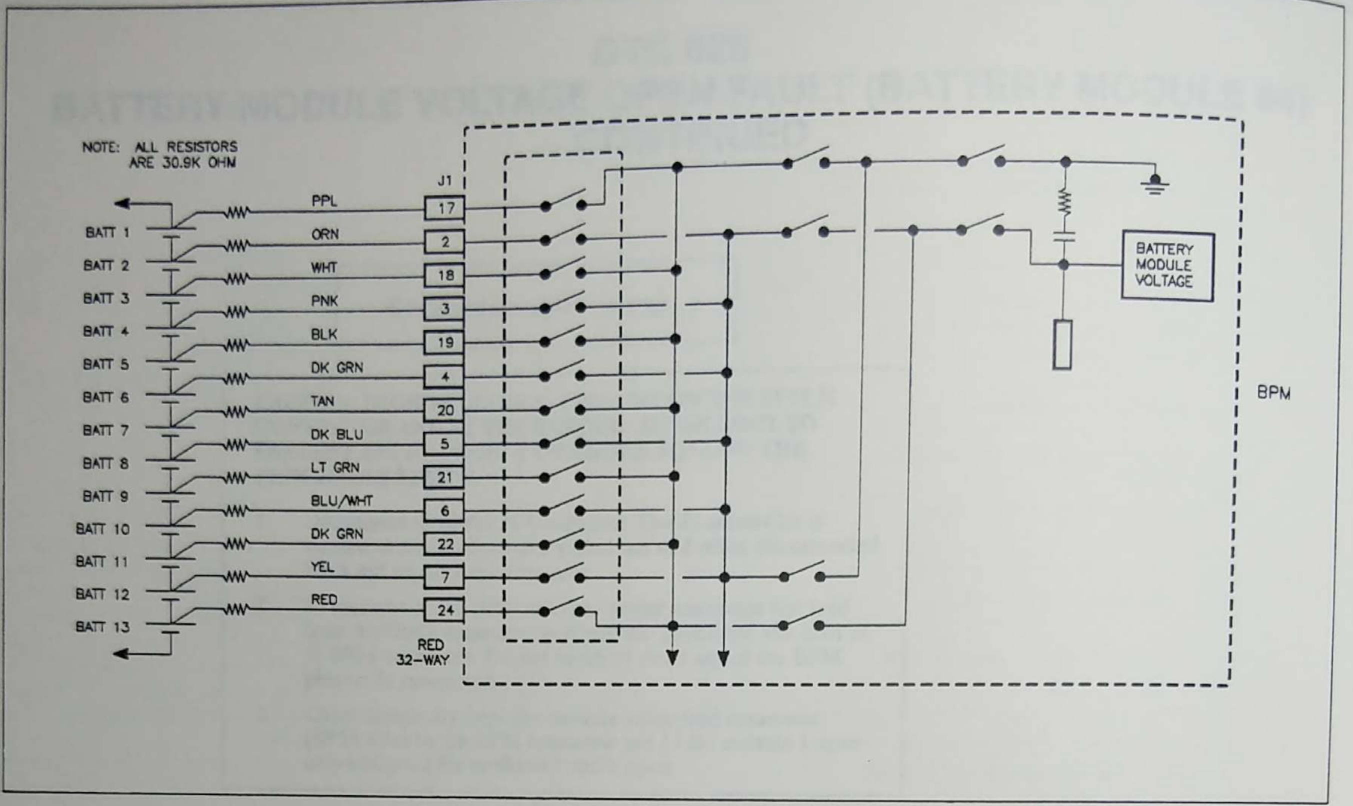
CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 027 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #4)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is 0 to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #4: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

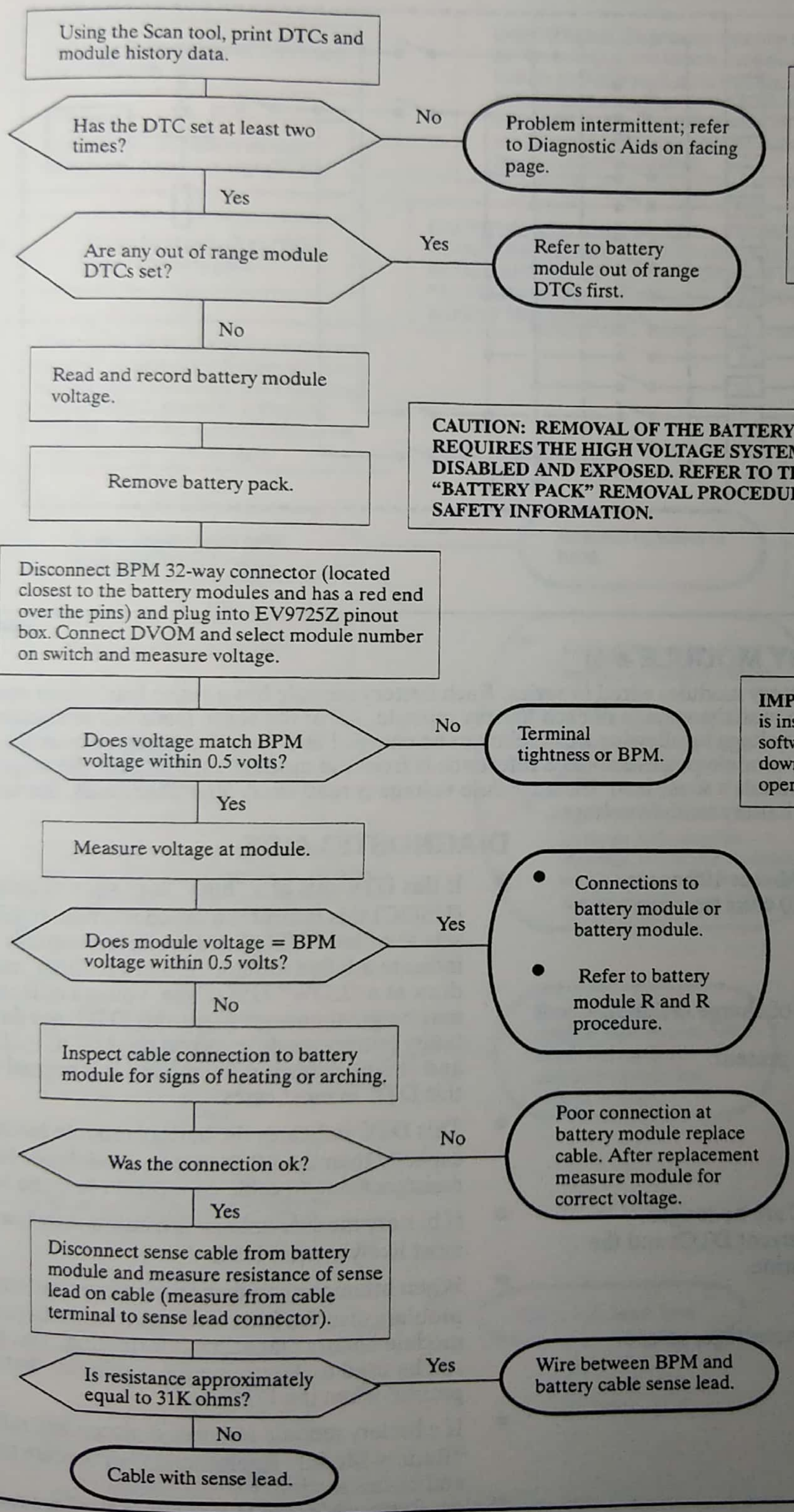
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

DTC 027
MARGINAL (BATTERY MODULE #4)


Using the Scan tool, print DTCs and module history data.
Has the DTC set at least two times?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any out of range module DTCs set?
Yes
Refer to battery module out of range DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Connections to battery module or battery module.
• Refer to battery module R and R procedure.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).
Is resistance approximately equal to 31K ohms?
Yes
Wire between BPM and battery cable sense lead.
No
Cable with sense lead.

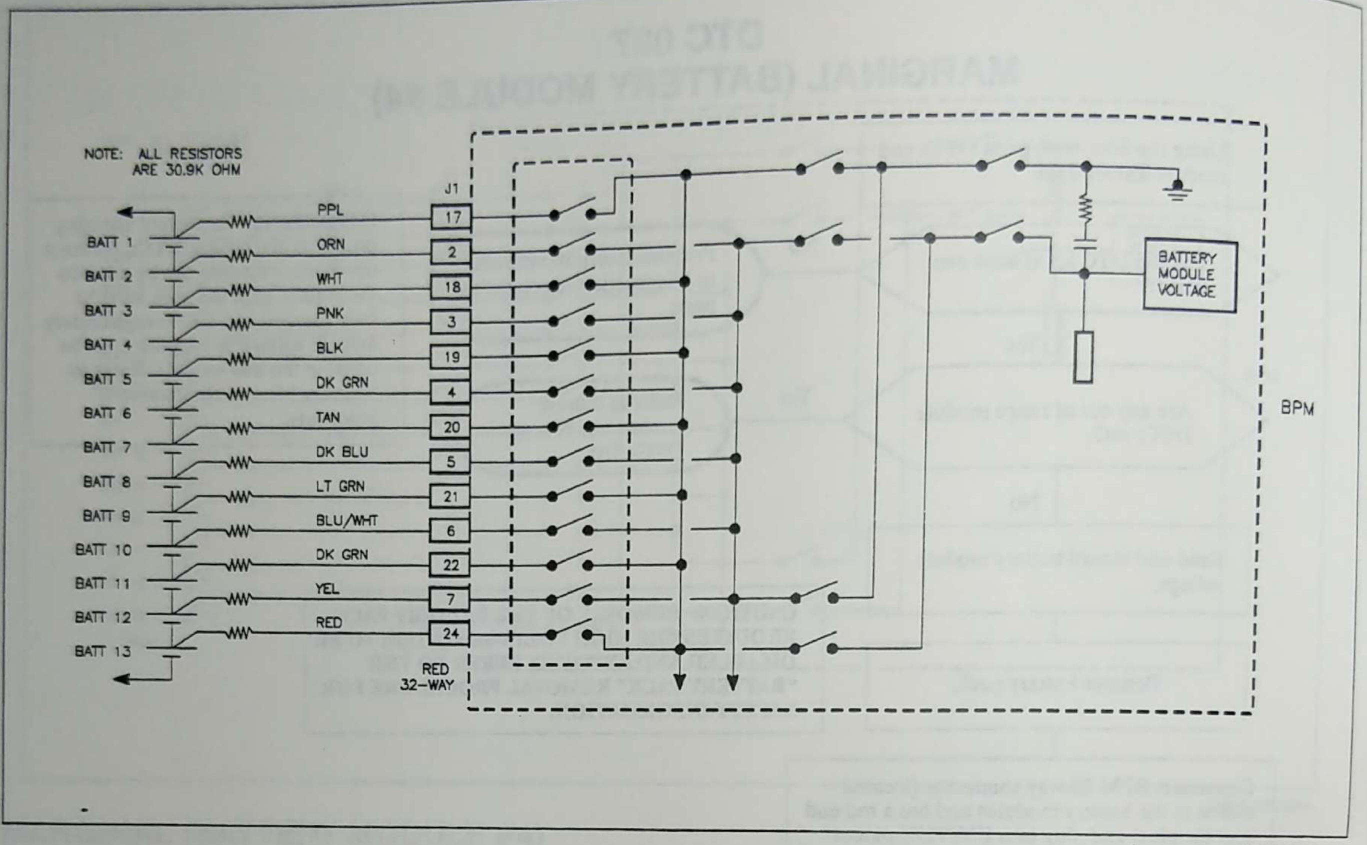
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

CS CamScanner

DTC 028 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #4)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is 0 to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #4: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

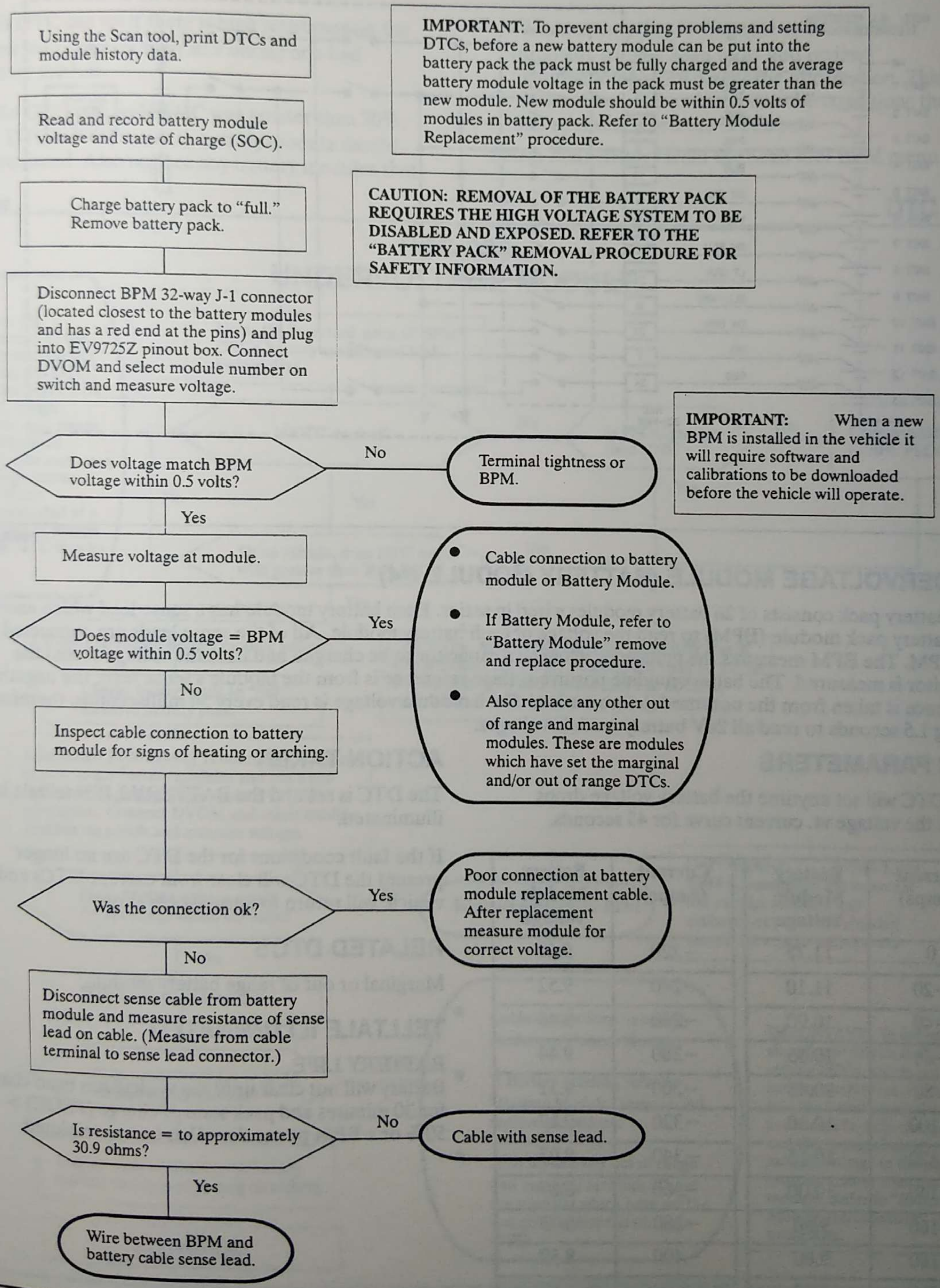
None

DIAGNOSTIC AIDS

- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

*Select Battery Module History from the Scan tool BPM menu.

DTC 028
OUT OF RANGE (BATTERY MODULE #4)



Using the Scan tool, print DTCs and module history data.

Read and record battery module voltage and state of charge (SOC).

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

No: Terminal tightness or BPM.

Yes: Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

Yes:
- Cable connection to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

No: Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Yes: Poor connection at battery module replacement cable. After replacement measure module for correct voltage.

No: Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)

Is resistance = to approximately 30.9 ohms?

No: Cable with sense lead.

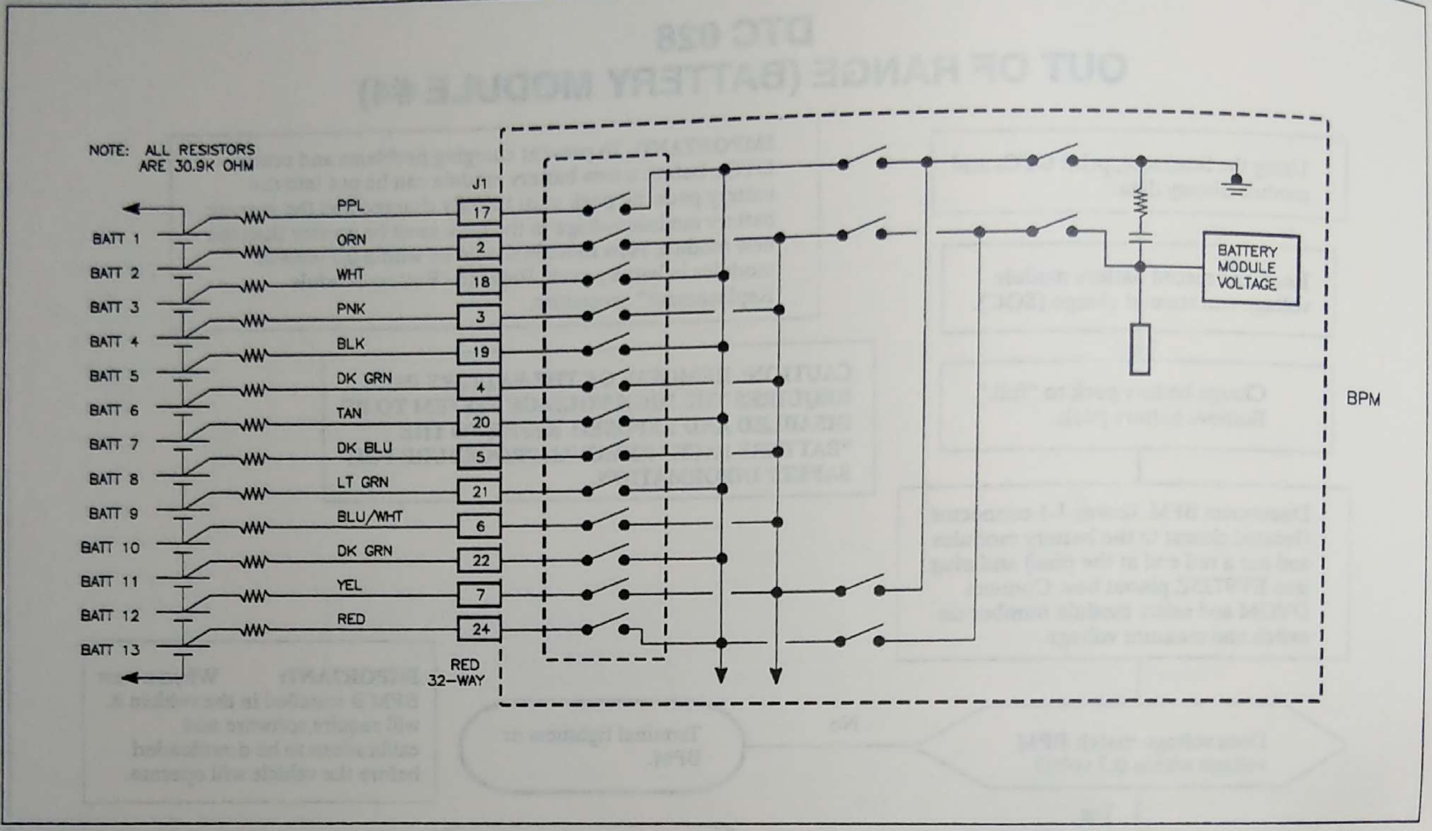
Yes: Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 029 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
J1
17
2
18
3
19
4
20
5
21
6
22
7
24
RED
32–WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #4)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage	Current (Amps)	Battery Module Voltage
0	11.75	−220	9.60
−20	11.10	−240	9.52
−40	10.90	−260	9.48
−60	10.65	−280	9.44
−80	10.45	−300	9.31
−100	10.30	−320	9.17
−120	10.15	−340	9.03
−140	10.00	−360	8.87
−160	9.90	−380	8.73
−180	9.80	−400	8.59
−200	9.70		

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

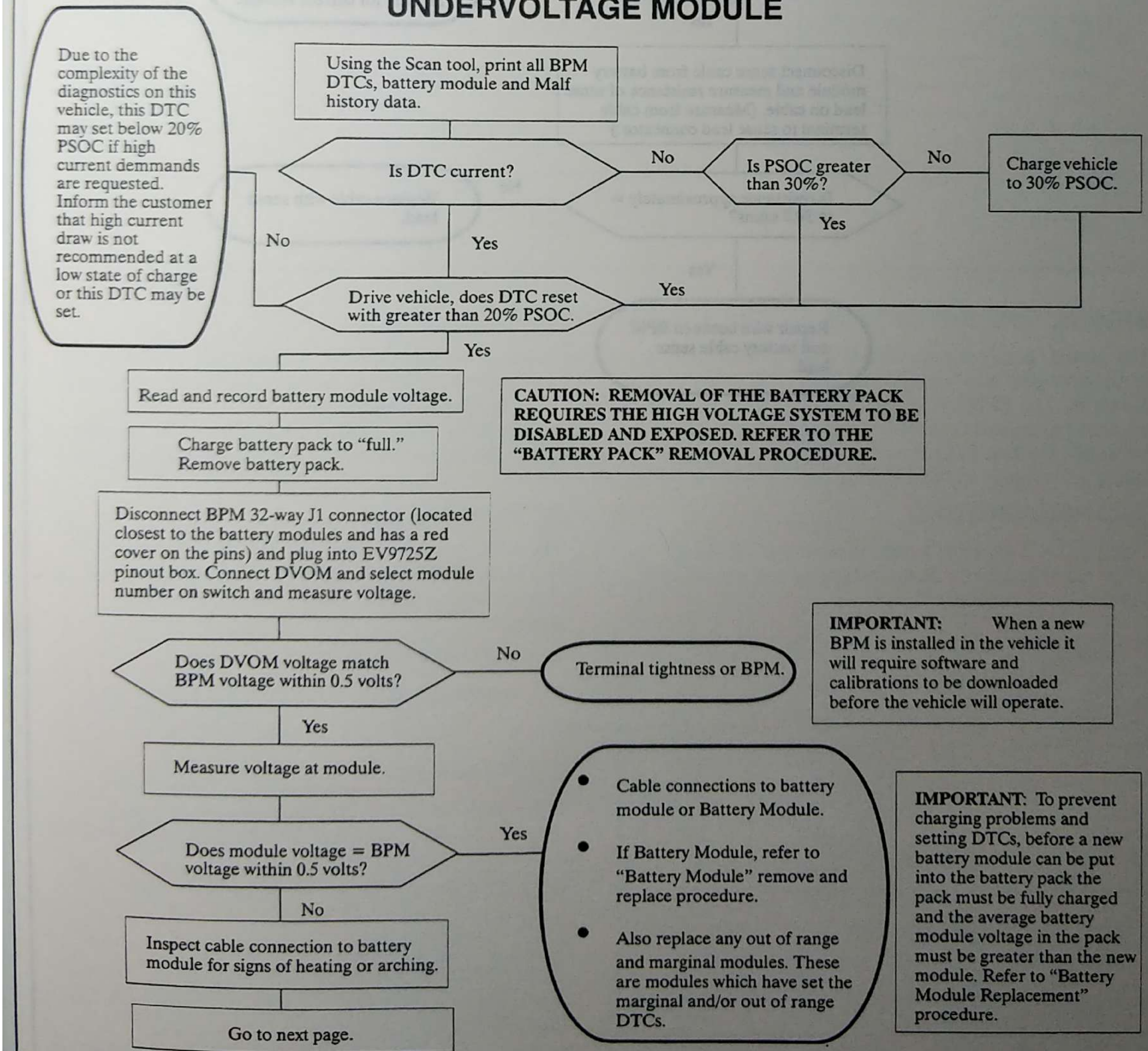
DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below 0% user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 029

DTC 029
UNDERVOLTAGE MODULE


Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

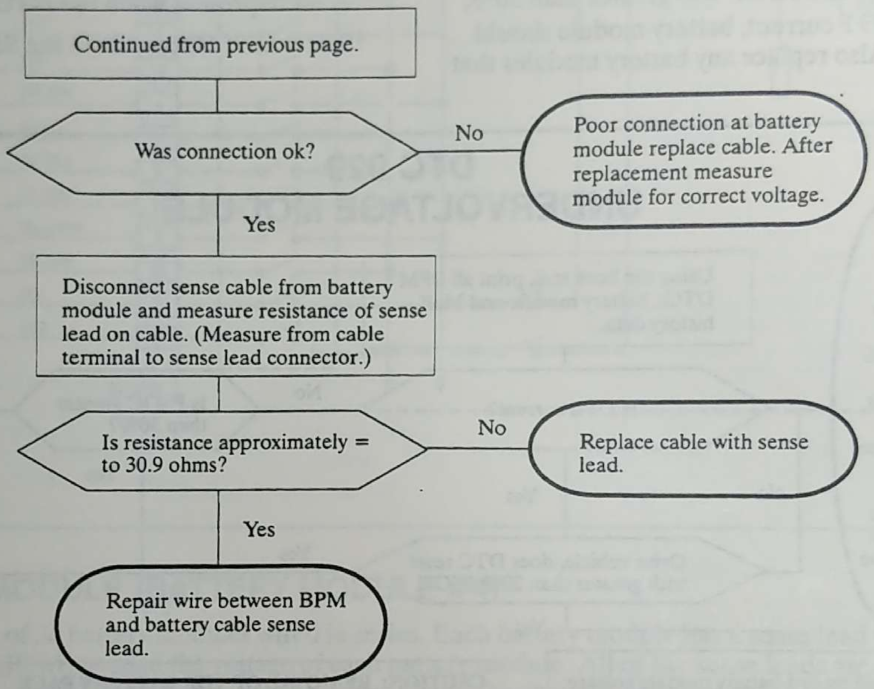
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

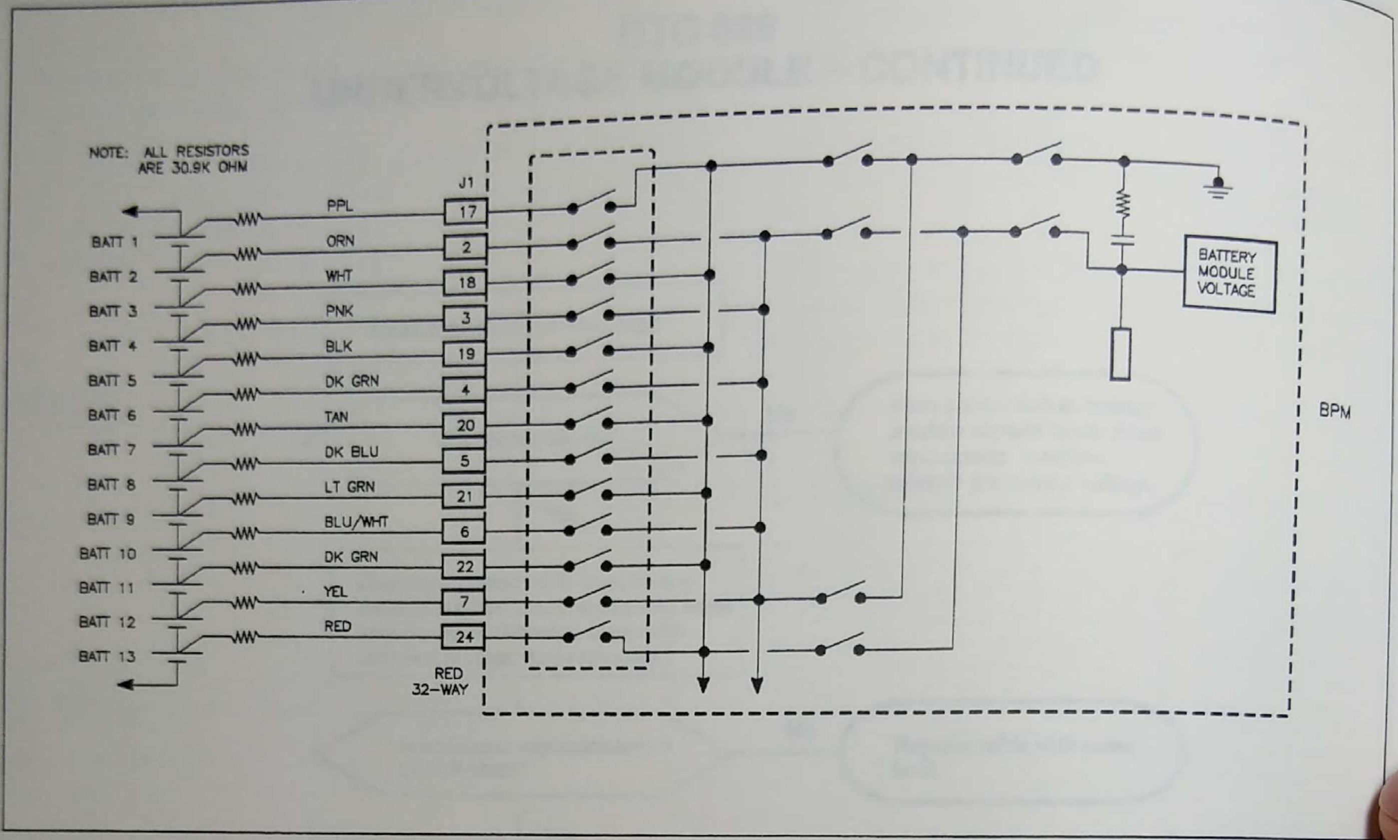
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 029
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 030 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #4)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage
0	11.45
-20	10.55
-40	10.20
-60	9.95
-80	9.75
-100	9.60
-120	9.45
-140	9.30
-160	9.20
-180	9.10
-200	9.00
-220	8.90
-240	8.82
-260	8.78
-280	8.74
-300	8.70
-320	8.66
-340	8.58
-360	8.43
-380	8.28
-400	8.14

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

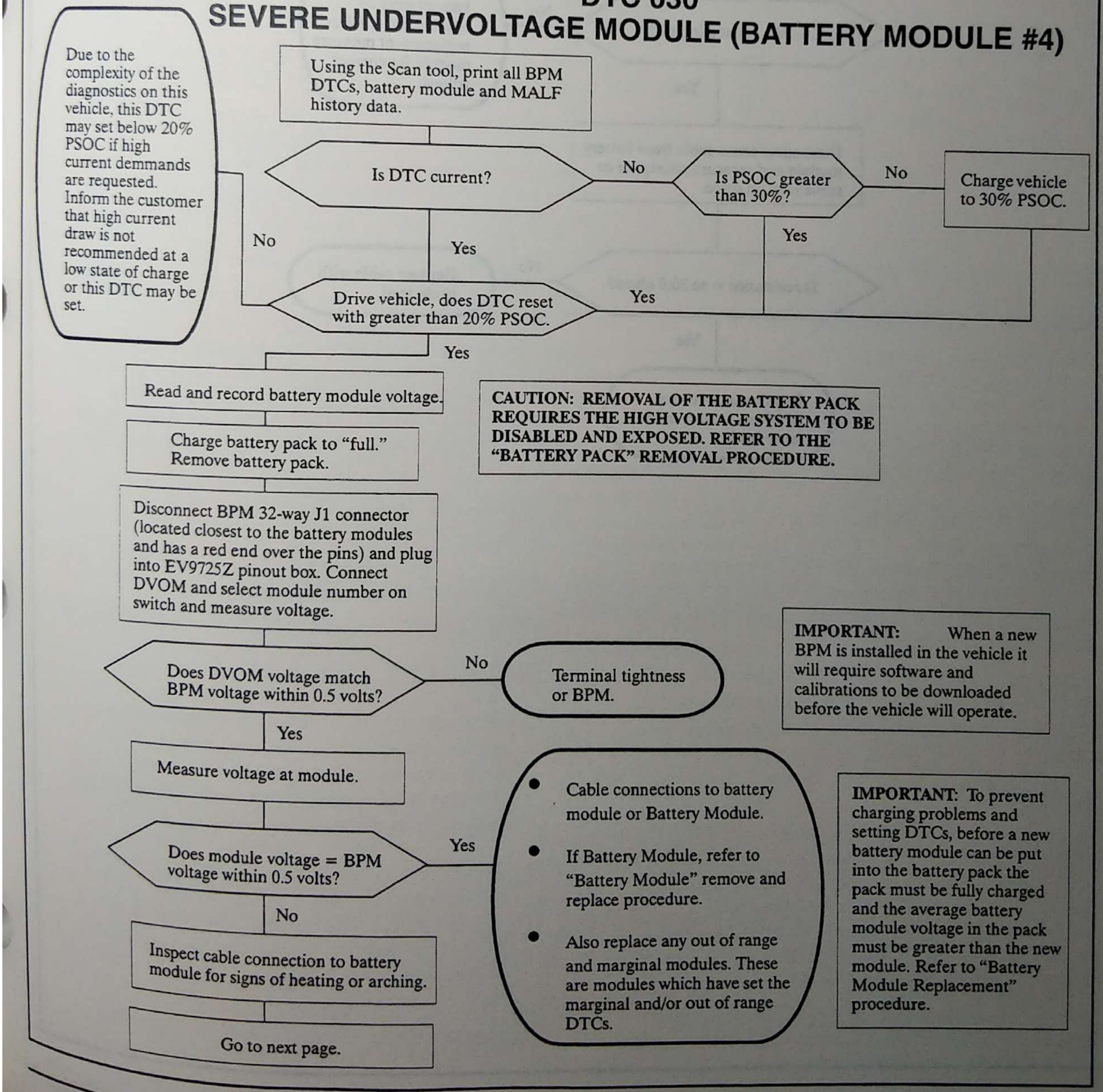
CS CamScanner

DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches 0% user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 030
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #4)



Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

Using the Scan tool, print all BPM DTCs, battery module and MALF history data.

Is DTC current?

Is PSOC greater than 30%?

Charge vehicle to 30% PSOC.

Drive vehicle, does DTC reset with greater than 20% PSOC.

Read and record battery module voltage.

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

Inspect cable connection to battery module for signs of heating or arching.

Go to next page.

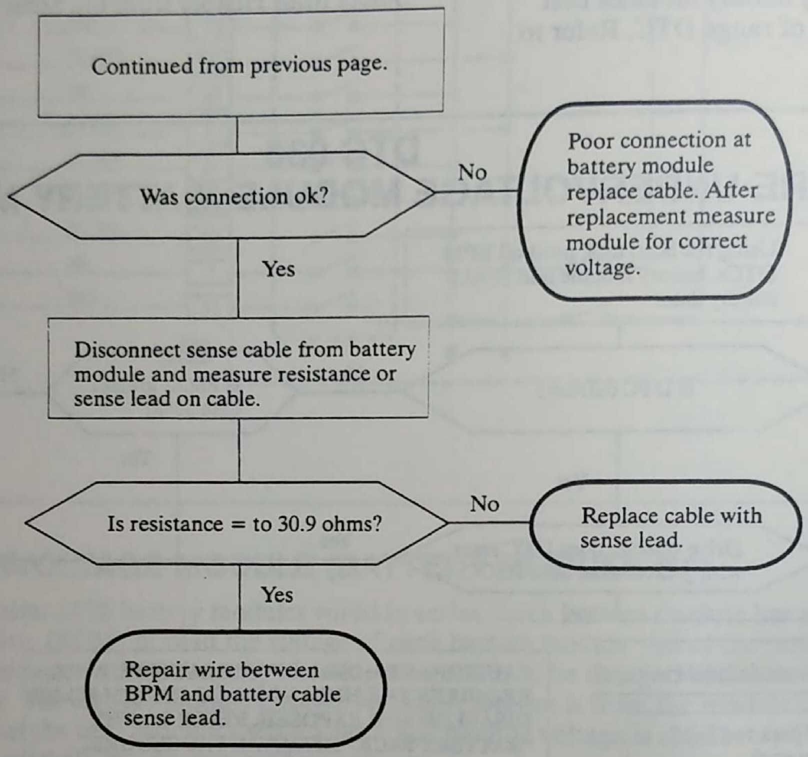
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

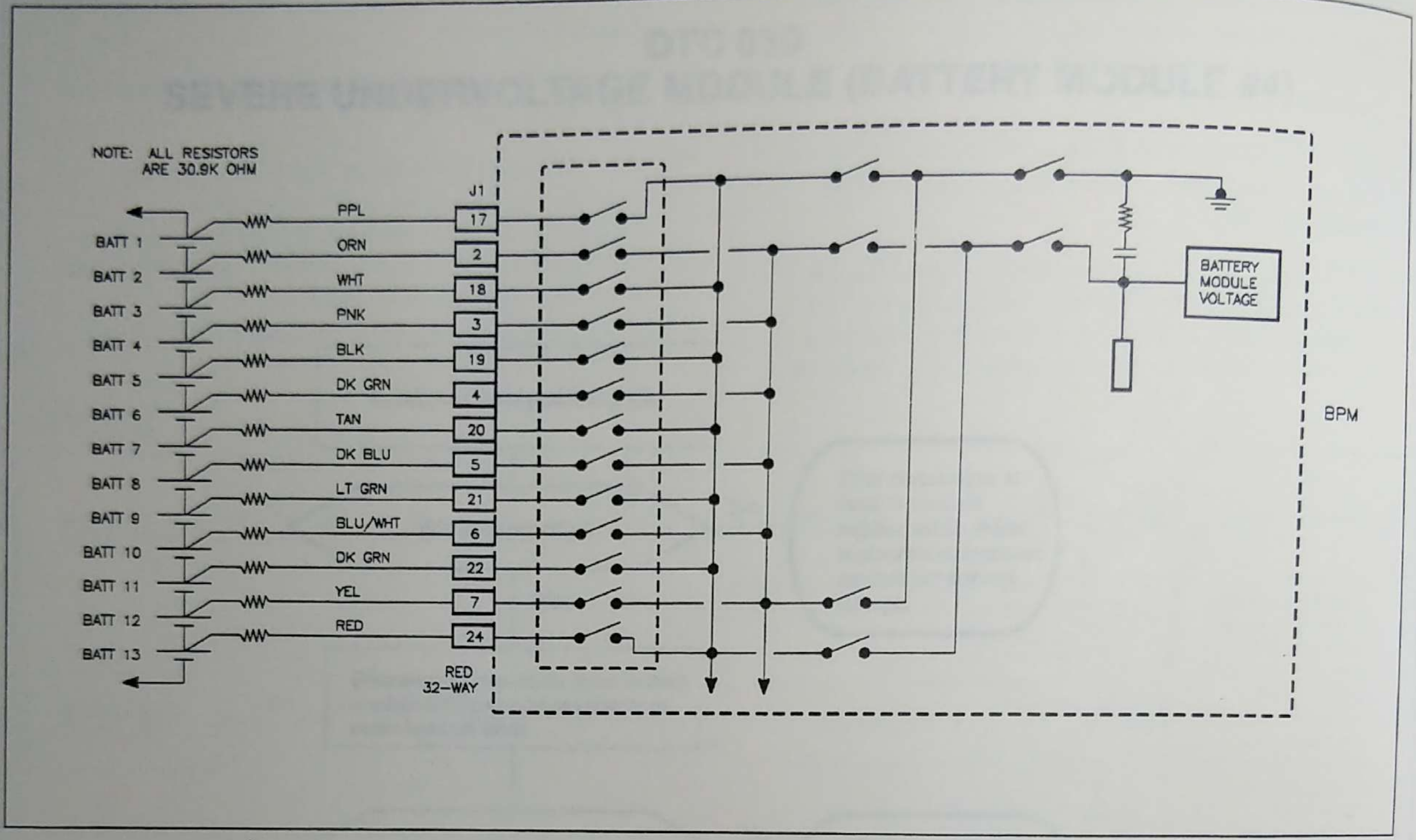
DTC 030

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #4)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 031 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #4)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

SERVICE NOW and REDUCED PERFORMANCE

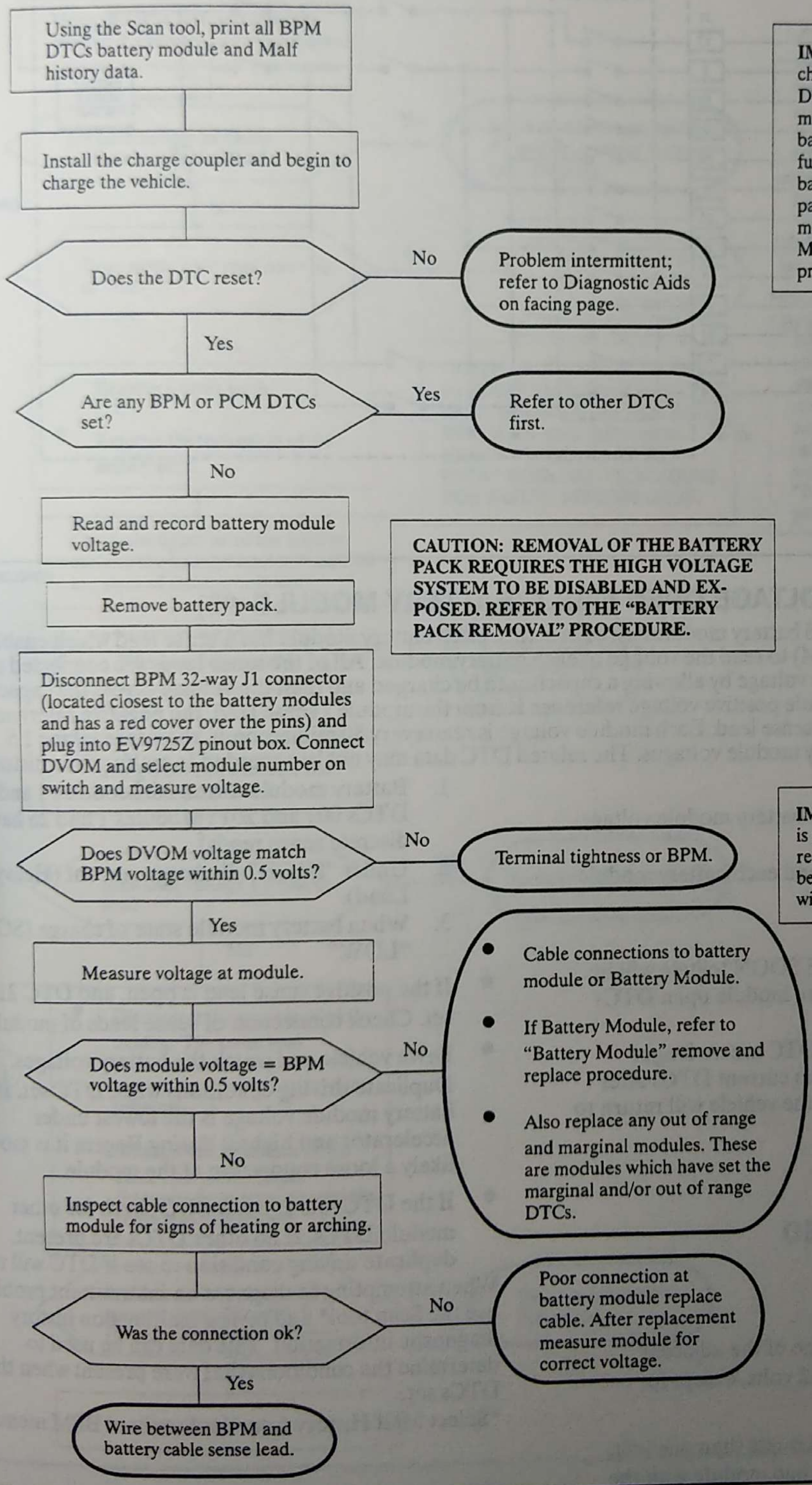
DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

CS CamScanner

DTC 031
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #4)

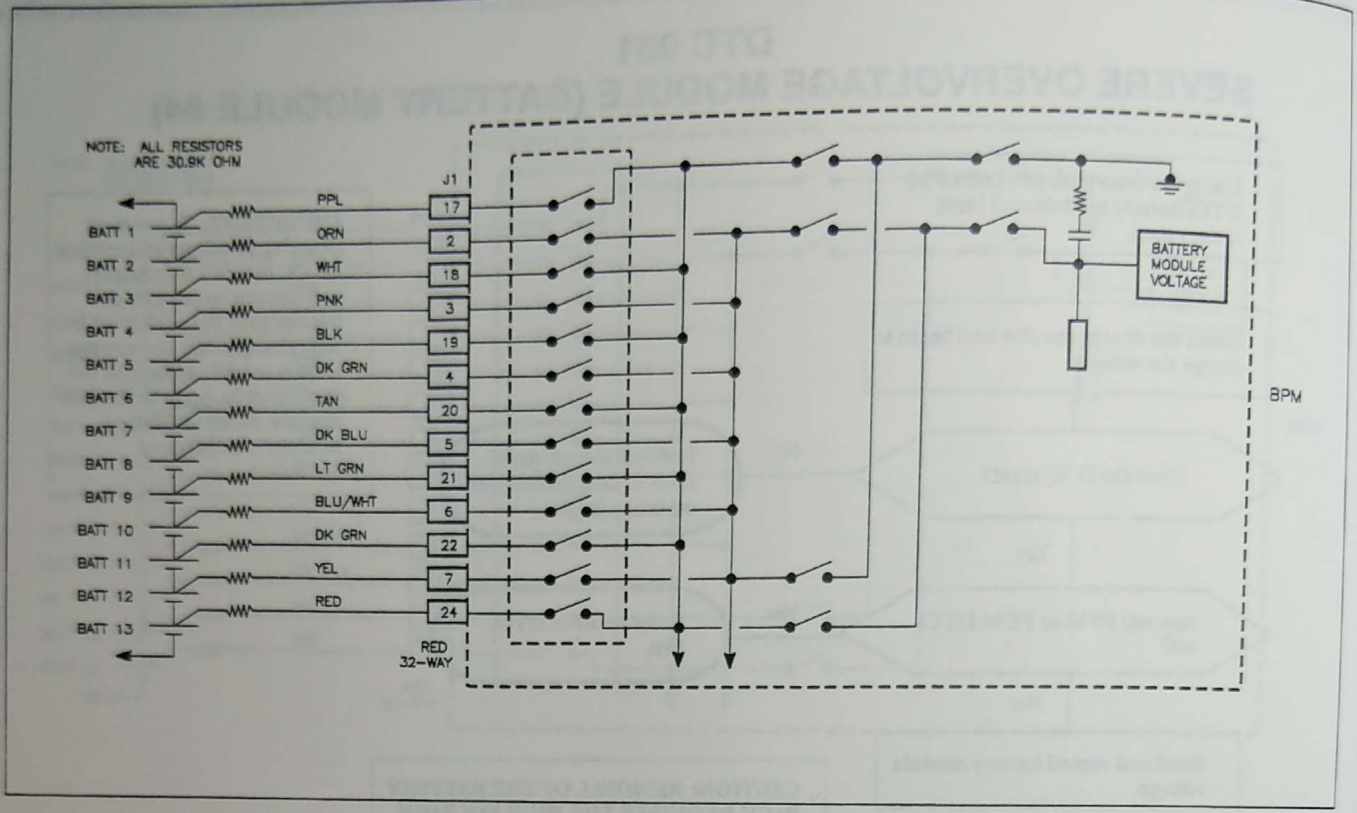

Using the Scan tool, print all BPM DTCs battery module and Malf history data.
Install the charge coupler and begin to charge the vehicle.
Does the DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any BPM or PCM DTCs set?
Yes
Refer to other DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
No
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 033 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #5)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

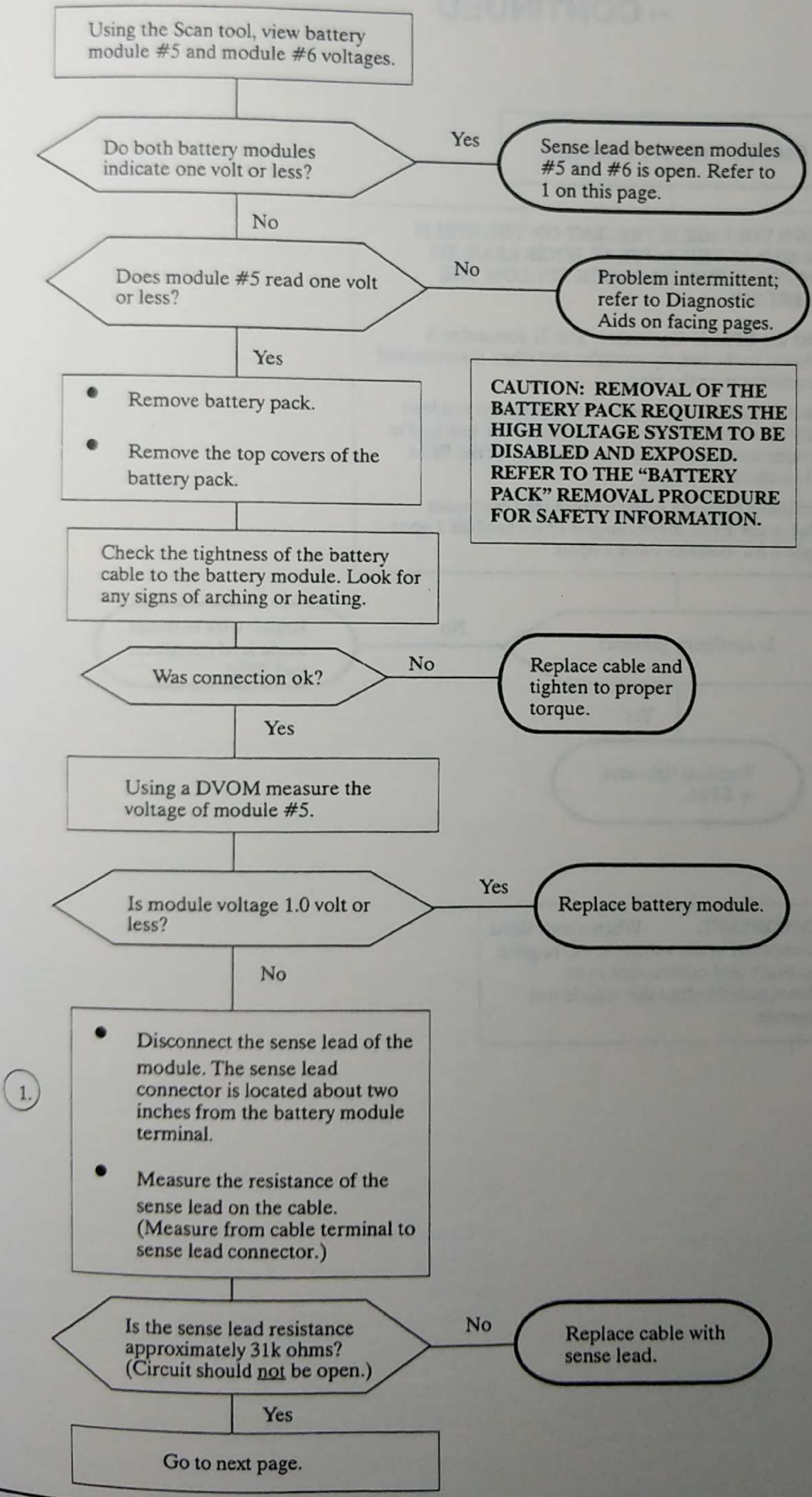
DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:
  1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
  2. Under "HIGH" discharge current (Heavy Load).
  3. When battery module state of charge (SOC) is "LOW."
- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 033
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #5)



Using the Scan tool, view battery module #5 and module #6 voltages.

Do both battery modules indicate one volt or less?

Yes: Sense lead between modules #5 and #6 is open. Refer to 1 on this page.

No: Does module #5 read one volt or less?

No: Problem intermittent; refer to Diagnostic Aids on facing pages.

Yes:

- Remove battery pack.
- Remove the top covers of the battery pack.

Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.

Was connection ok?

No: Replace cable and tighten to proper torque.

Yes: Using a DVOM measure the voltage of module #5.

Is module voltage 1.0 volt or less?

Yes: Replace battery module.

No:

1.
- Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
- Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)

Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)

No: Replace cable with sense lead.

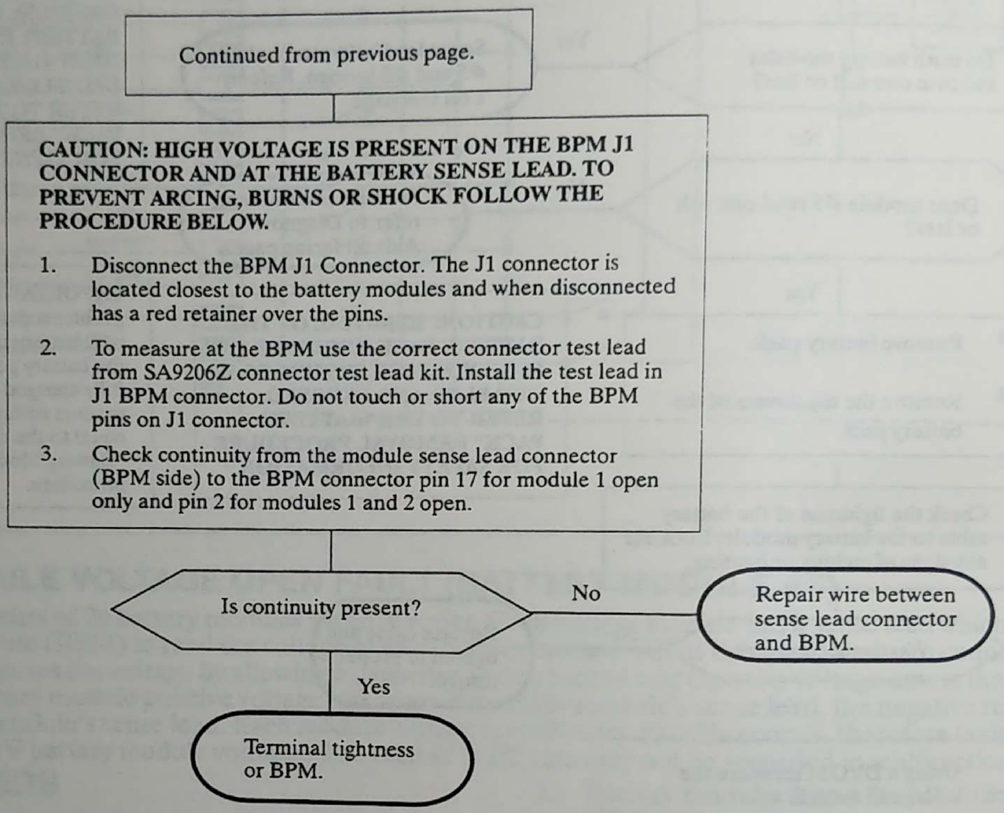
Yes: Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 033
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #5) – CONTINUED



Continued from previous page.

CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

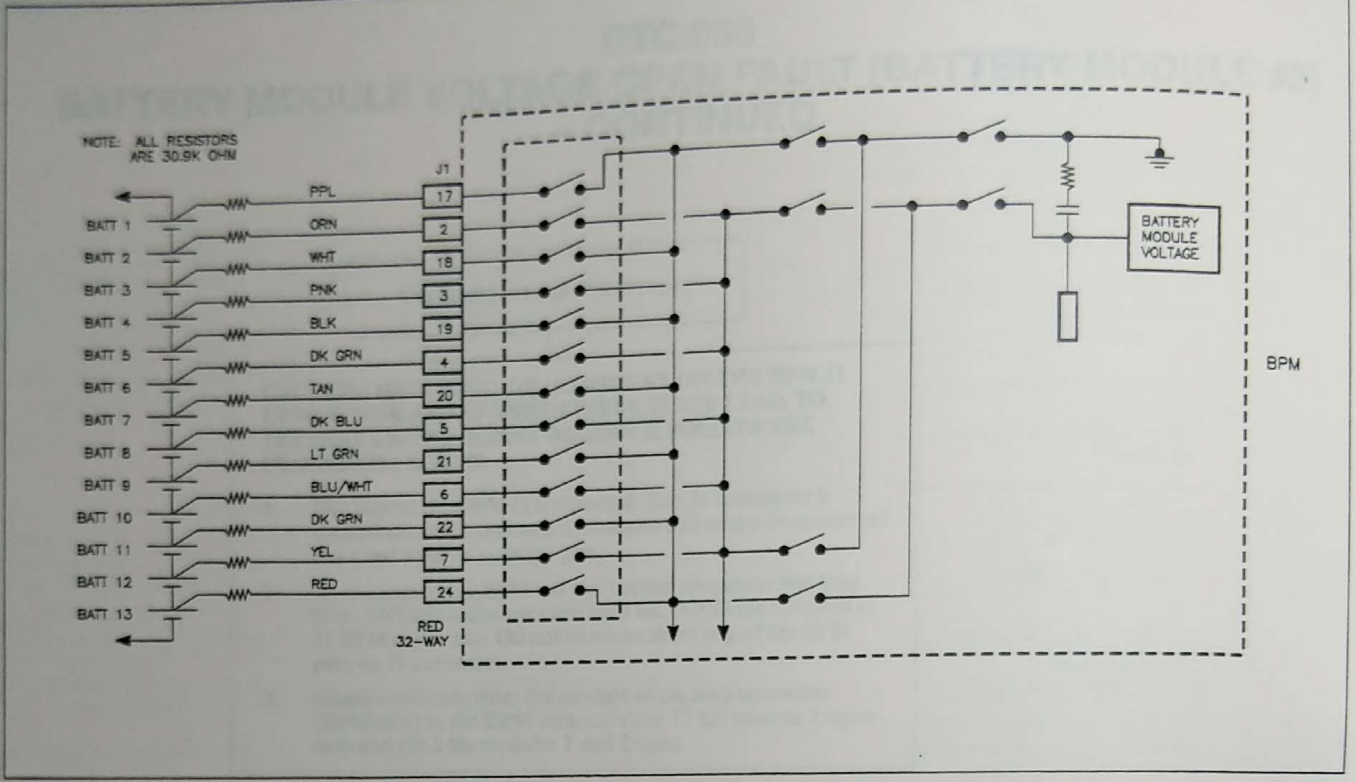
1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

Is continuity present?
No
Repair wire between sense lead connector and BPM.
Yes
Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 035 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #5)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is 0 to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #5: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

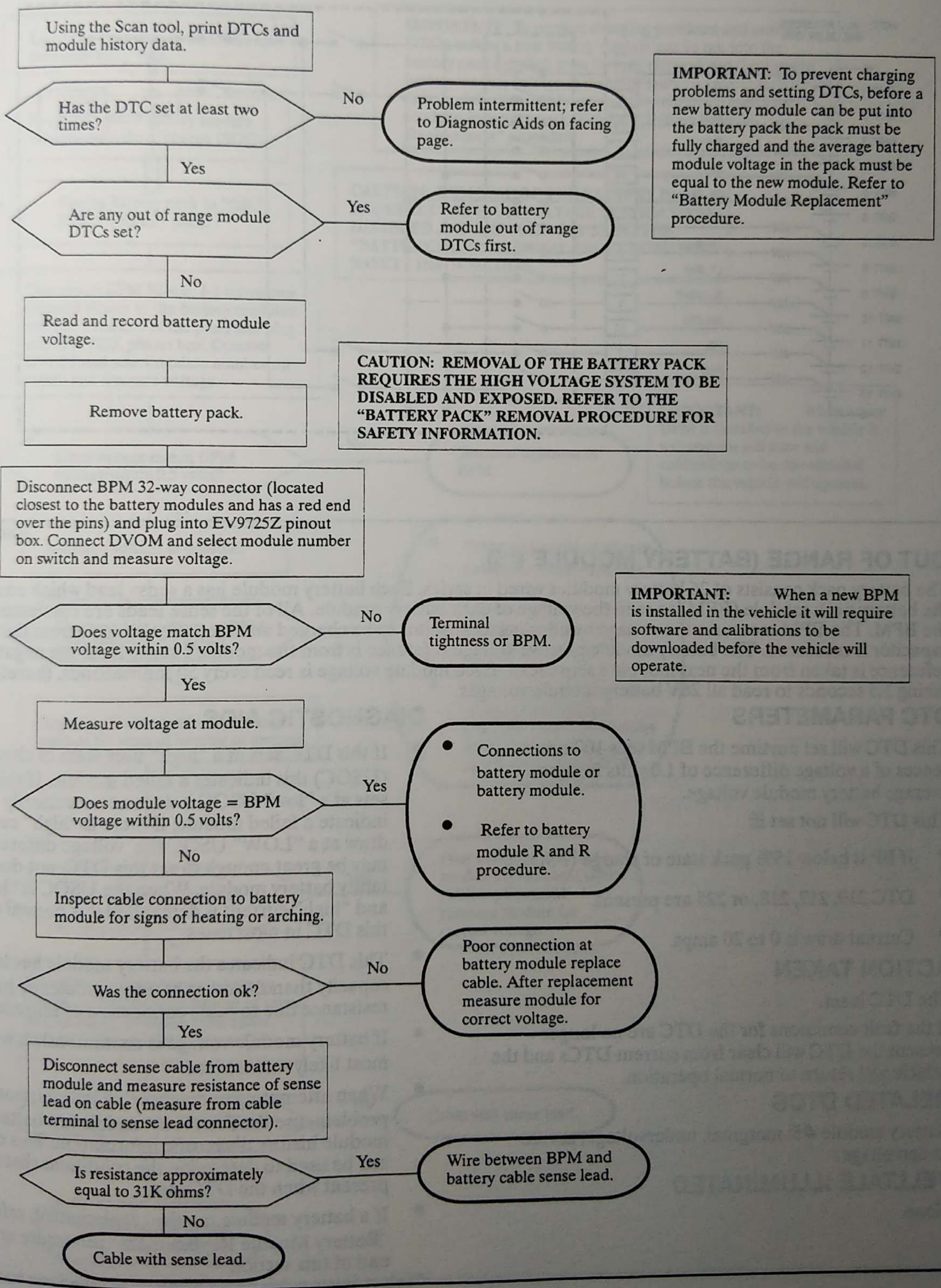
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

DTC 035
MARGINAL (BATTERY MODULE #5)



Using the Scan tool, print DTCs and module history data.

Has the DTC set at least two times?

No

Problem intermittent; refer to Diagnostic Aids on facing page.

Yes

Are any out of range module DTCs set?

Yes

Refer to battery module out of range DTCs first.

No

Read and record battery module voltage.

Remove battery pack.

Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

No

Terminal tightness or BPM.

Yes

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

Yes

- Connections to battery module or battery module.
- Refer to battery module R and R procedure.

No

Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

No

Poor connection at battery module replace cable. After replacement measure module for correct voltage.

Yes

Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).

Is resistance approximately equal to 31K ohms?

Yes

Wire between BPM and battery cable sense lead.

No

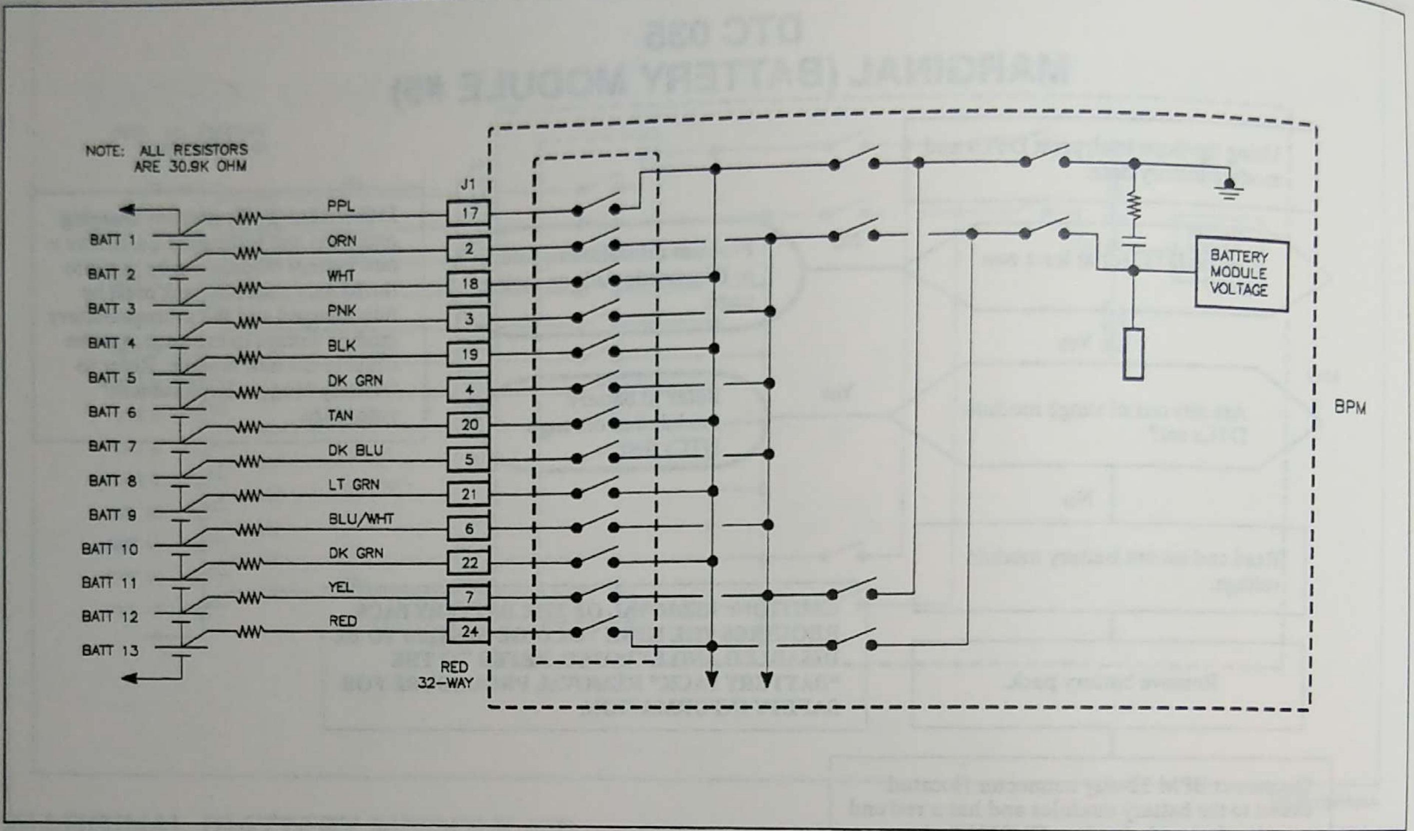
Cable with sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 036 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #5)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is 0 to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #5: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

None

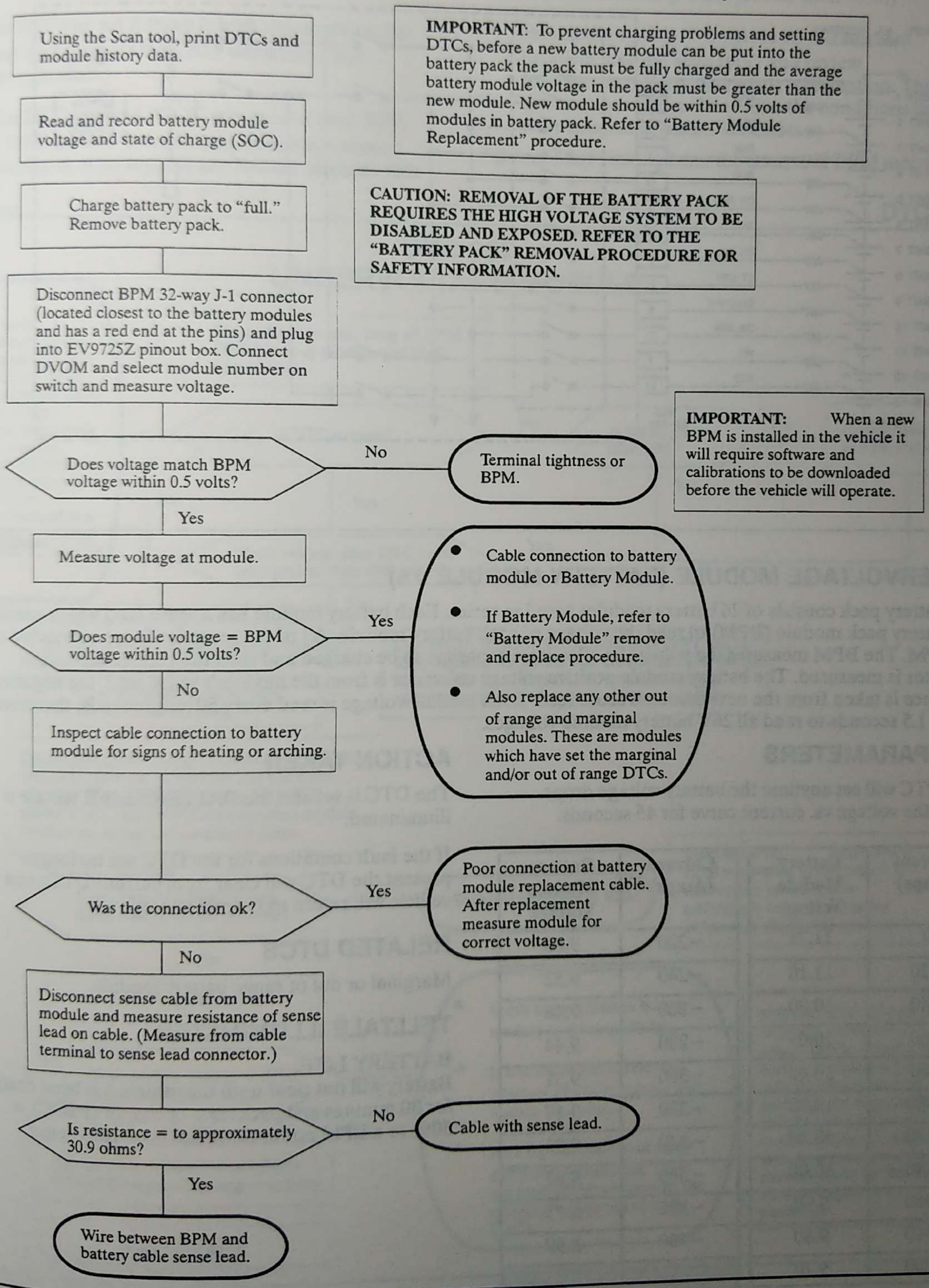
DIAGNOSTIC AIDS

- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

*Select Battery Module History from the Scan tool BPM menu.

CS CamScanner

DTC 036
OUT OF RANGE (BATTERY MODULE #5)

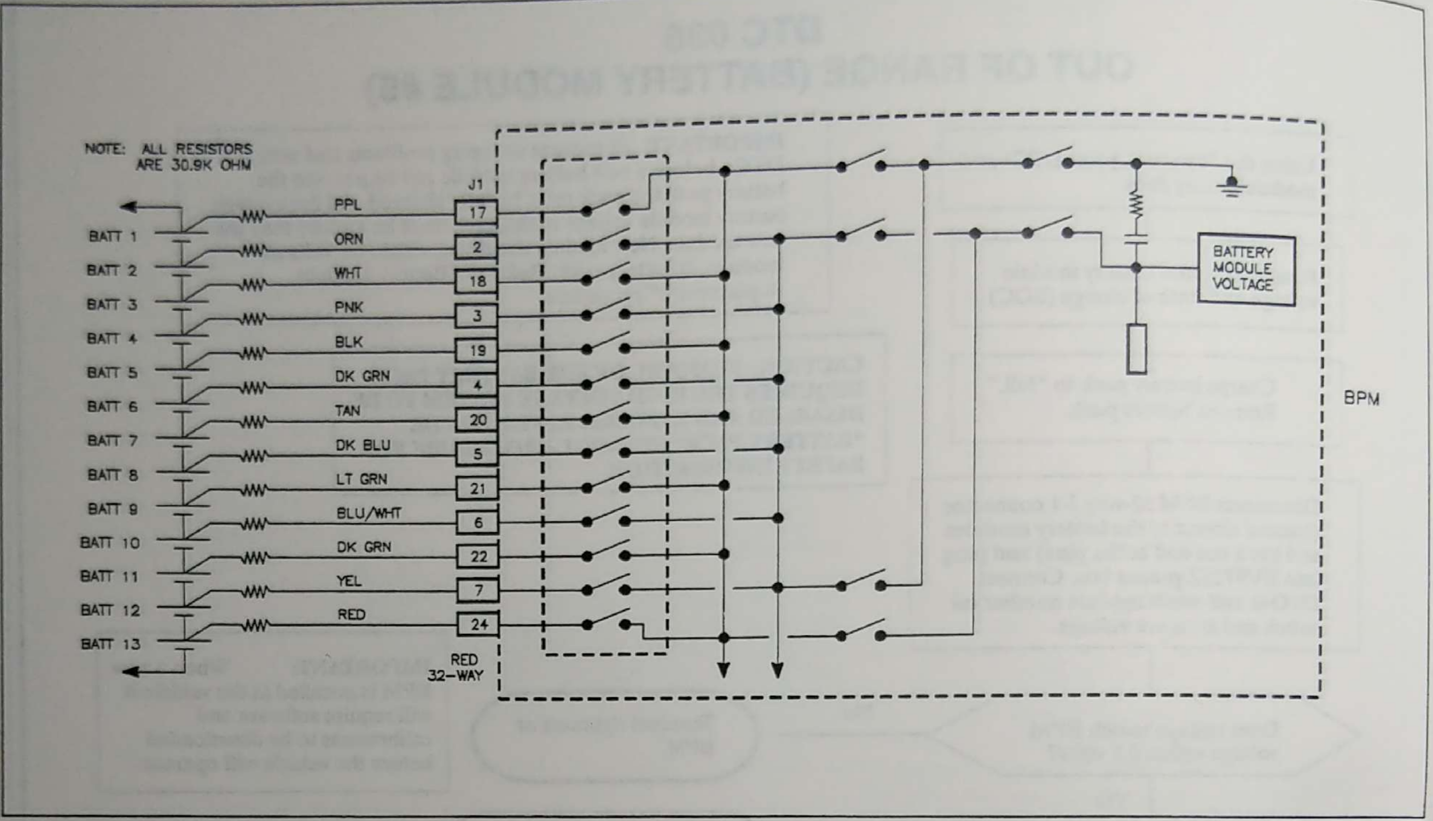

Using the Scan tool, print DTCs and module history data.
Read and record battery module voltage and state of charge (SOC).
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
Cable connection to battery module or Battery Module.
If Battery Module, refer to "Battery Module" remove and replace procedure.
Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
Yes
Poor connection at battery module replacement cable. After replacement measure module for correct voltage.
No
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance = to approximately 30.9 ohms?
No
Cable with sense lead.
Yes
Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 037 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32–WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #5)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage	Current (Amps)	Battery Module Voltage
0	11.75	−220	9.60
−20	11.10	−240	9.52
−40	10.90	−260	9.48
−60	10.65	−280	9.44
−80	10.45	−300	9.31
−100	10.30	−320	9.17
−120	10.15	−340	9.03
−140	10.00	−360	8.87
−160	9.90	−380	8.73
−180	9.80	−400	8.59
−200	9.70		

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

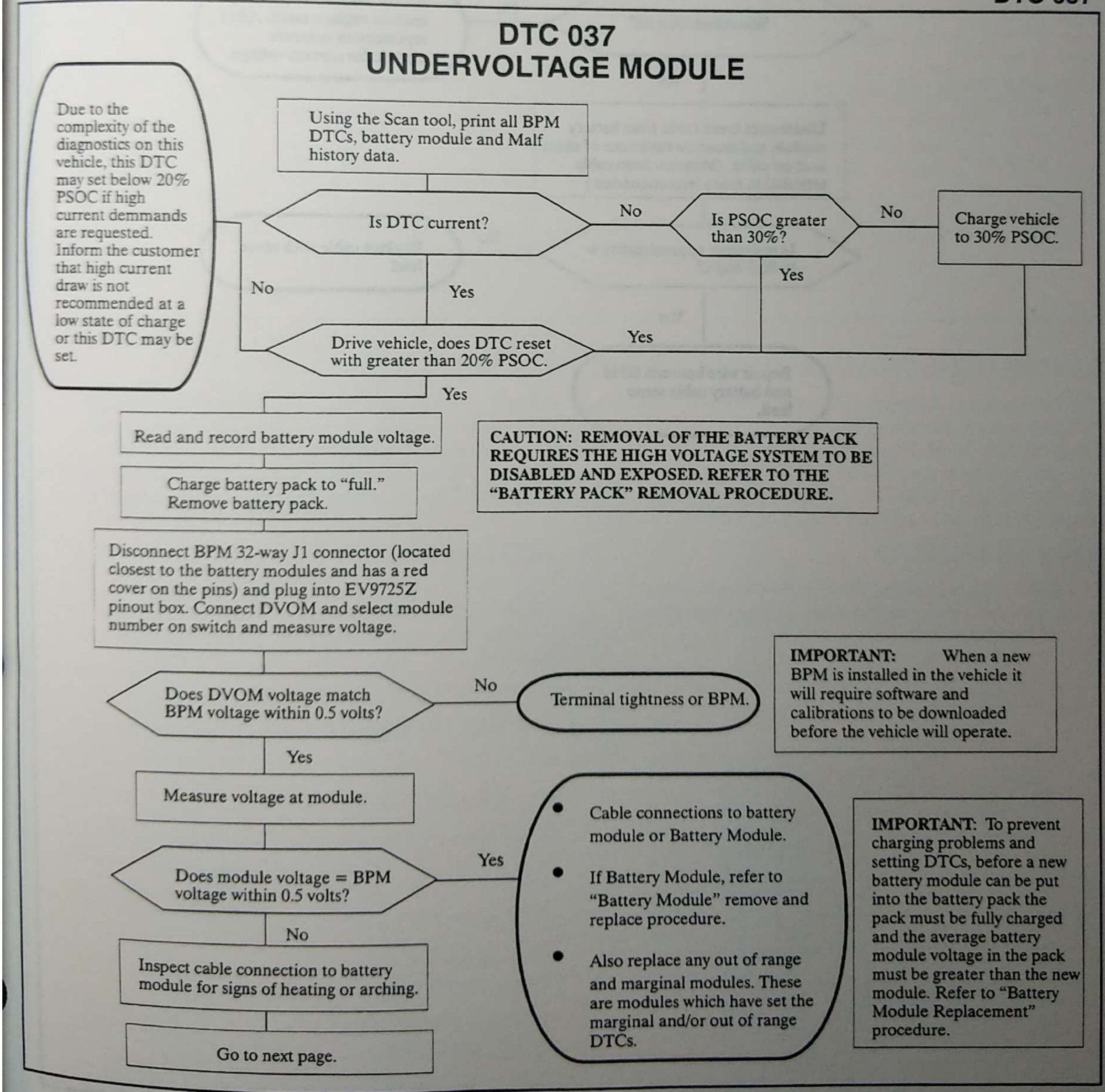
BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

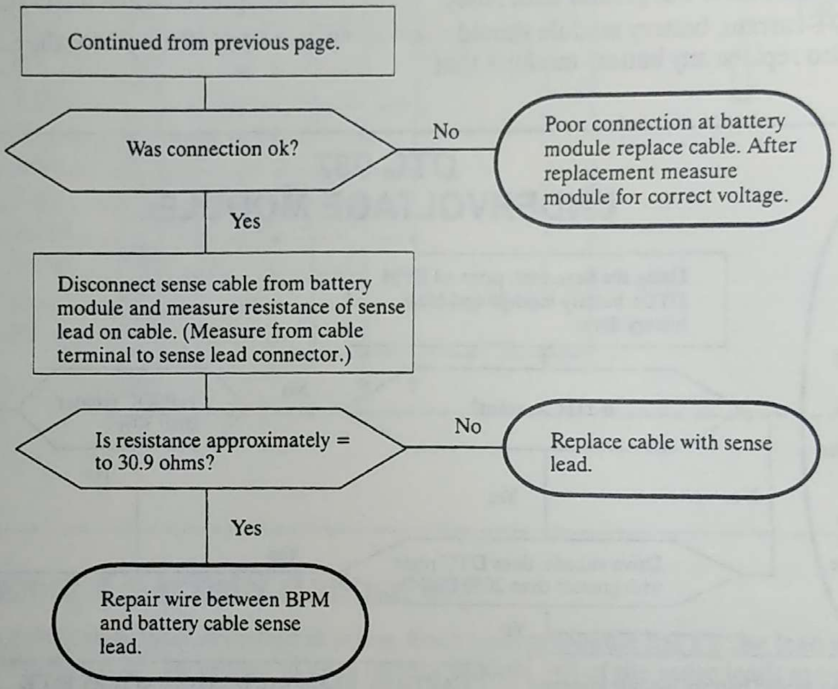
- This DTC can set if vehicle is driven below 0% user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 037
UNDERVOLTAGE MODULE

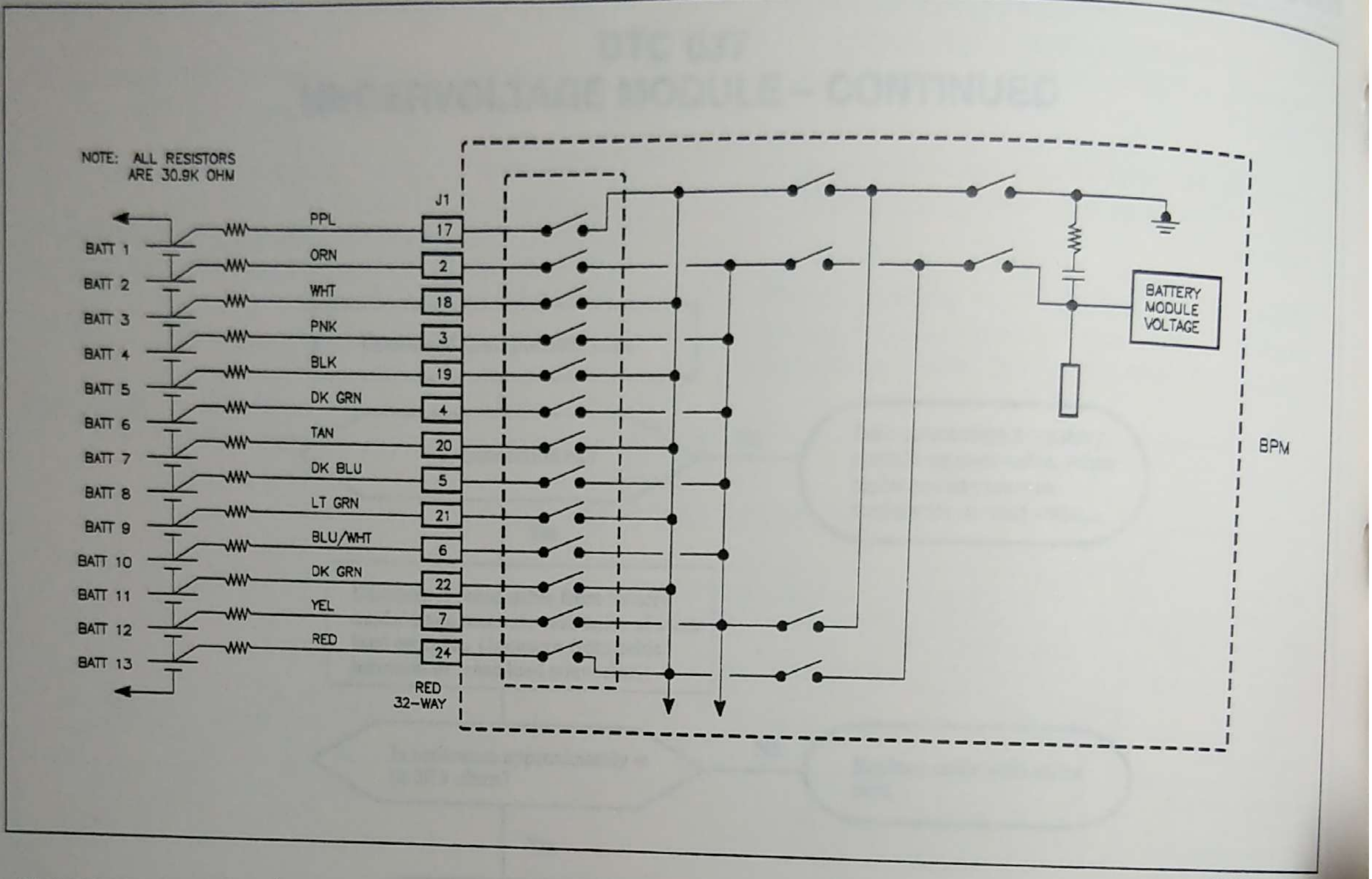

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

DTC 037
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 038 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
J1
17
2
18
3
19
4
20
5
21
6
22
7
24
RED
32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #5)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

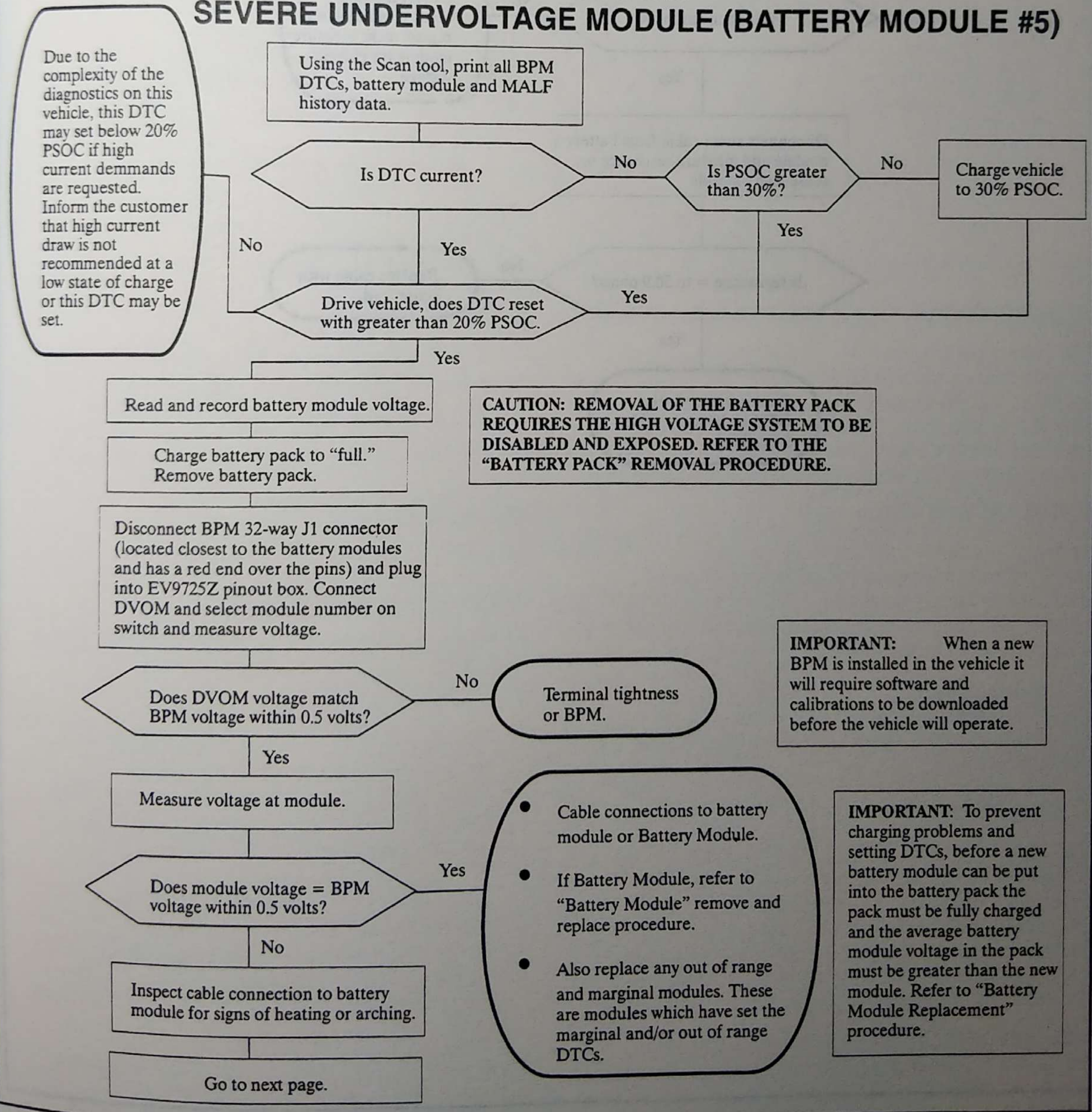
DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches 0% user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 038

DTC 038
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #5)

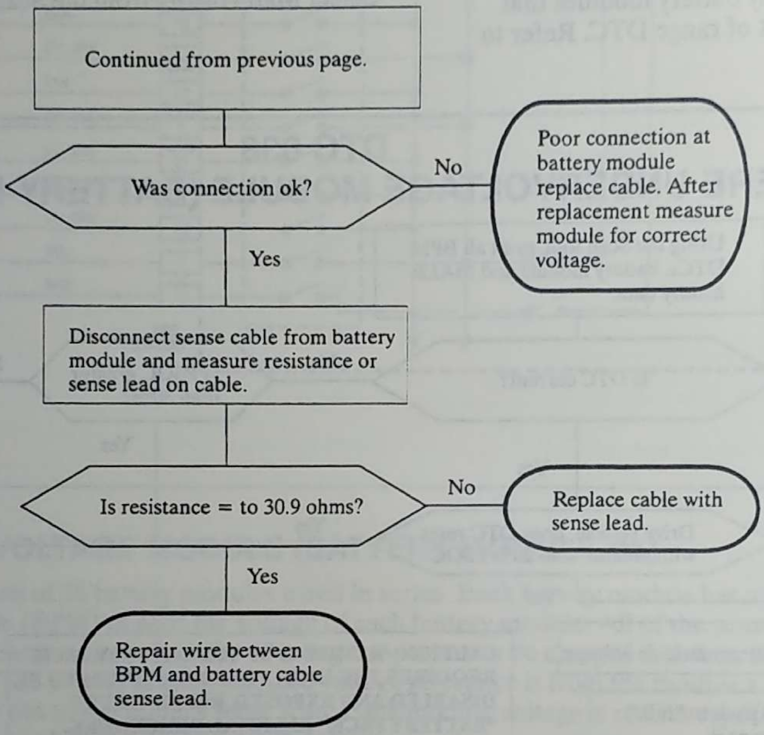

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and MALF history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

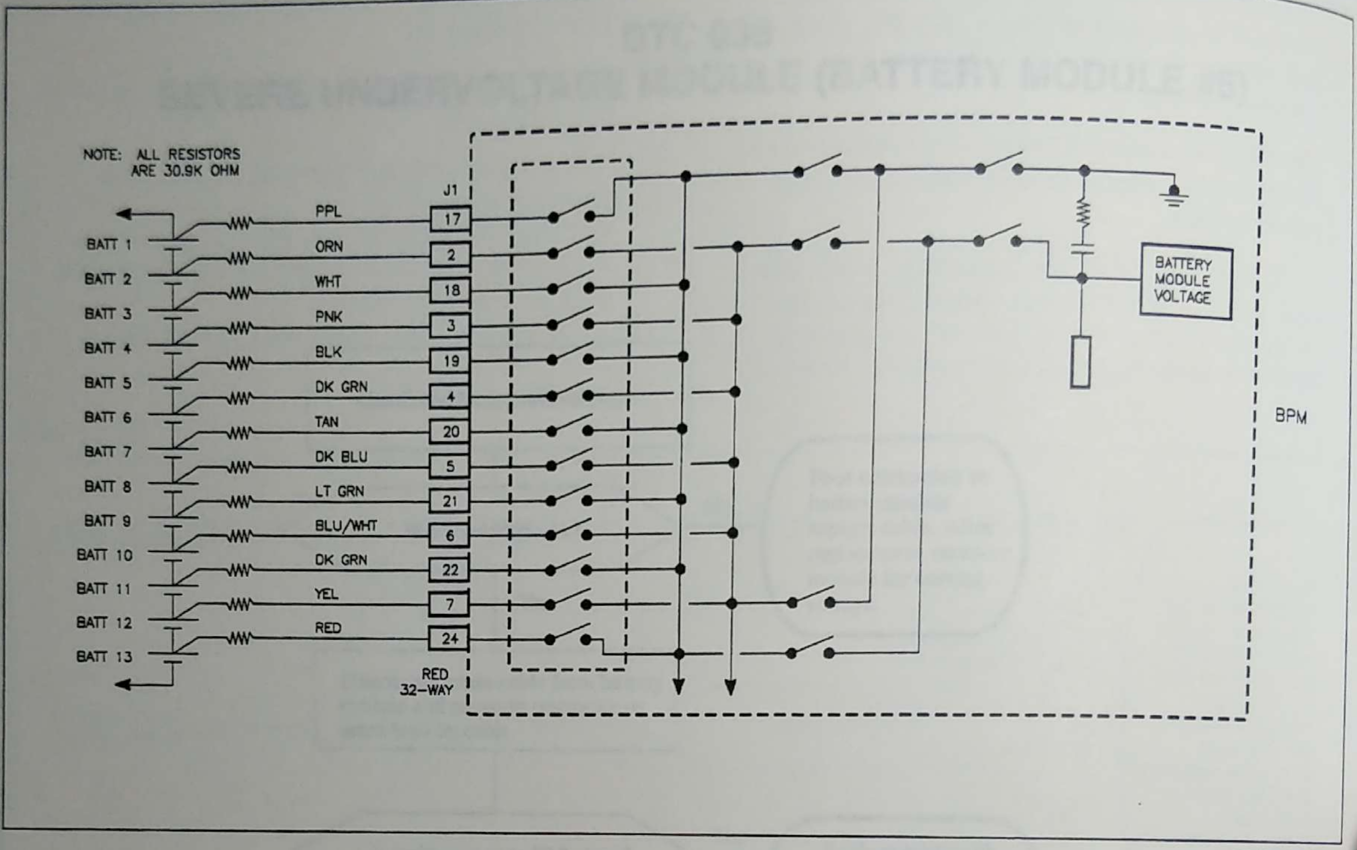
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 038
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #5)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 039 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #5)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

SERVICE NOW and REDUCED PERFORMANCE

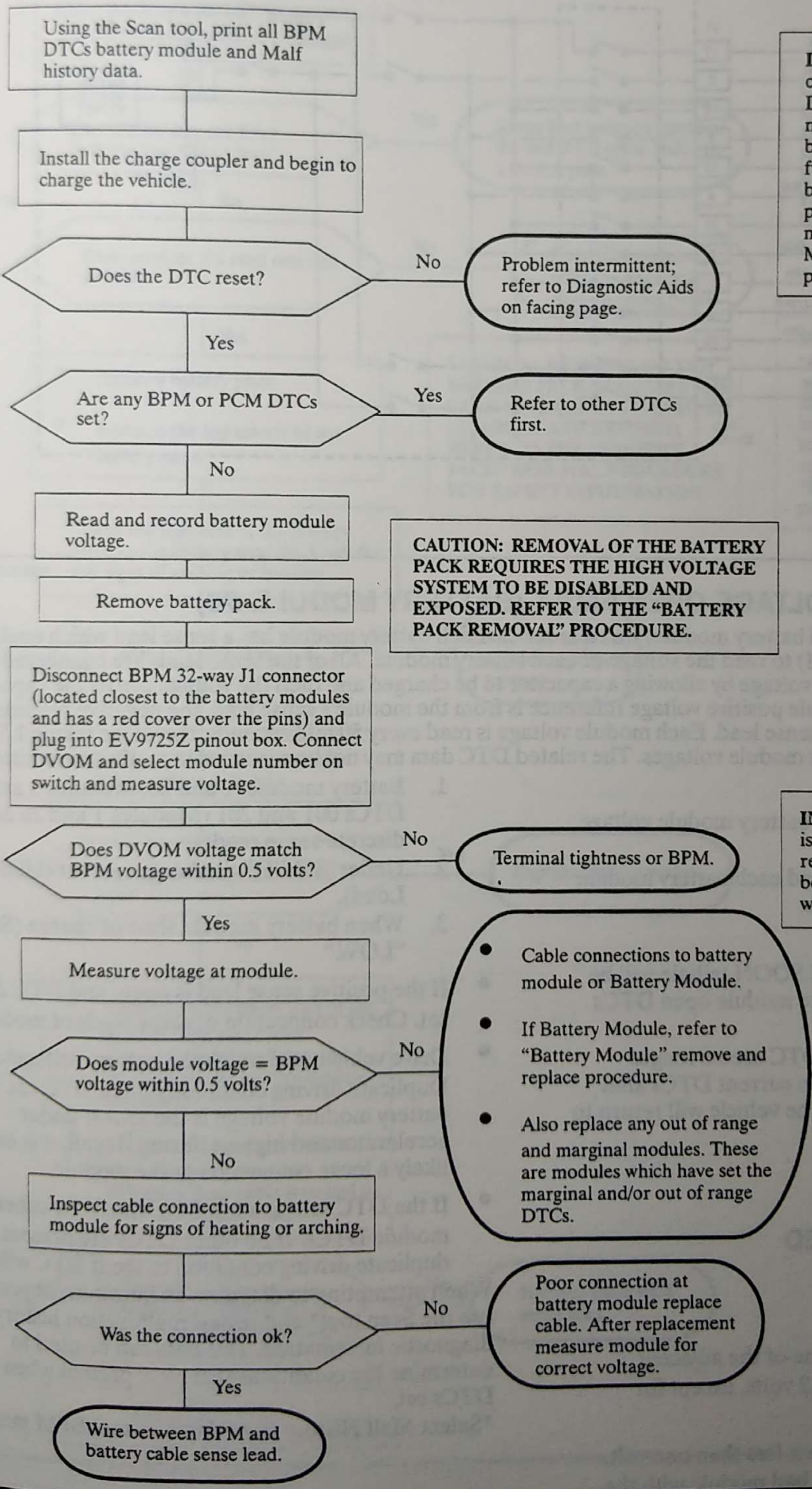
DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

DTC 039
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #5)

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.



Using the Scan tool, print all BPM DTCs battery module and Malf history data.

Install the charge coupler and begin to charge the vehicle.

Does the DTC reset?

Problem intermittent; refer to Diagnostic Aids on facing page.

Are any BPM or PCM DTCs set?

Refer to other DTCs first.

Read and record battery module voltage.

Remove battery pack.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Poor connection at battery module replace cable. After replacement measure module for correct voltage.

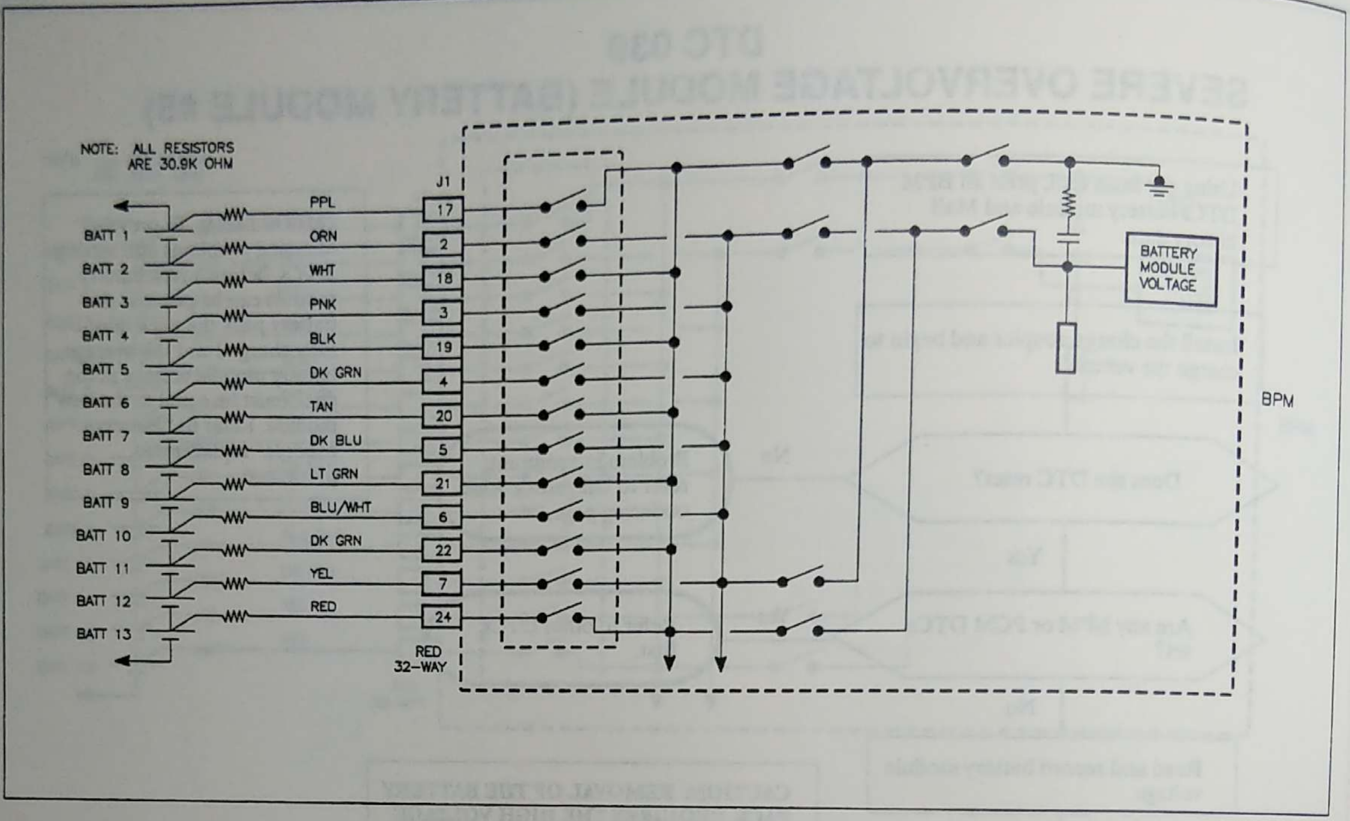
Wire between BPM and battery cable sense lead.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

CS CamScanner

DTC 041 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #6)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:

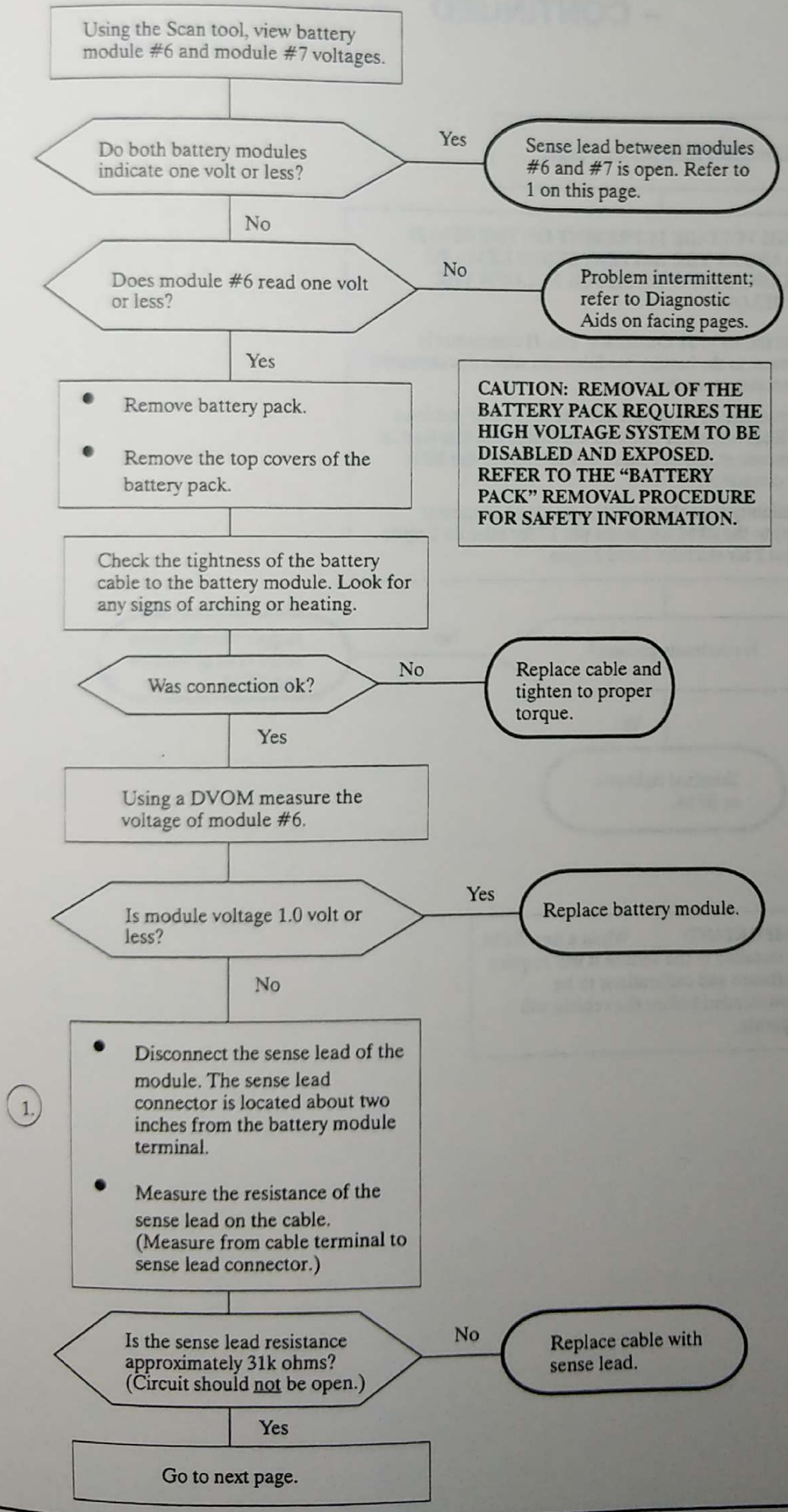
1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
2. Under "HIGH" discharge current (Heavy Load).
3. When battery module state of charge (SOC) is "LOW."

- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 041
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #6)


Using the Scan tool, view battery module #6 and module #7 voltages.
Do both battery modules indicate one volt or less?
Yes
Sense lead between modules #6 and #7 is open. Refer to 1 on this page.
No
Does module #6 read one volt or less?
No
Problem intermittent; refer to Diagnostic Aids on facing pages.
Yes
• Remove battery pack.
• Remove the top covers of the battery pack.
Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.
Was connection ok?
No
Replace cable and tighten to proper torque.
Yes
Using a DVOM measure the voltage of module #6.
Is module voltage 1.0 volt or less?
Yes
Replace battery module.
No
1.
• Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
• Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)
Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)
No
Replace cable with sense lead.
Yes
Go to next page.

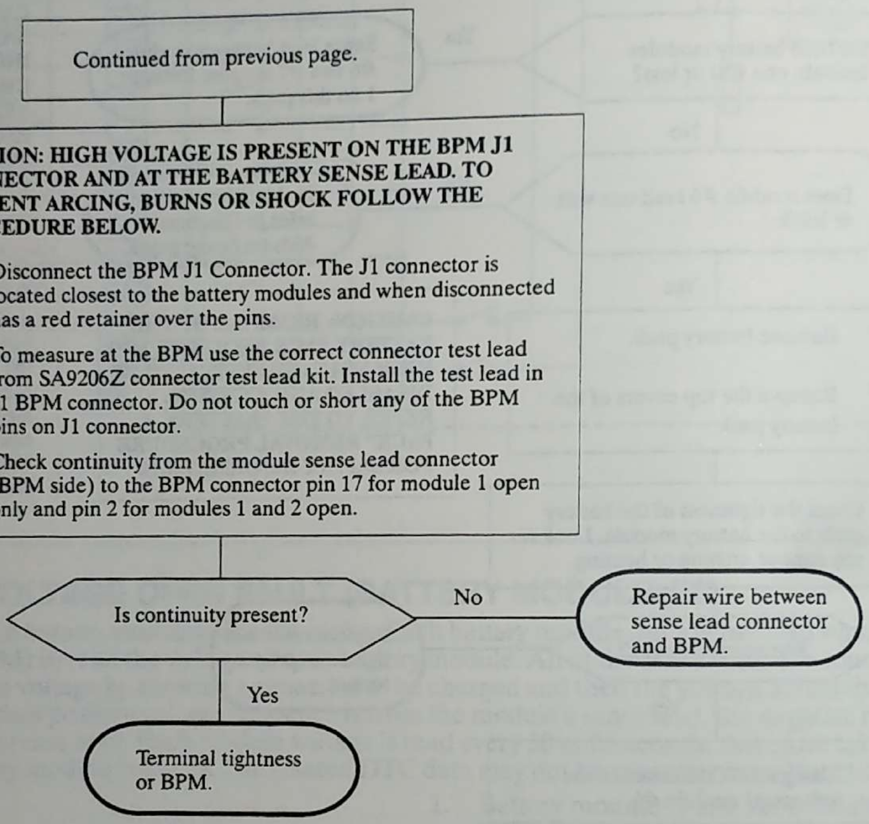
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 041

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #6) – CONTINUED



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CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

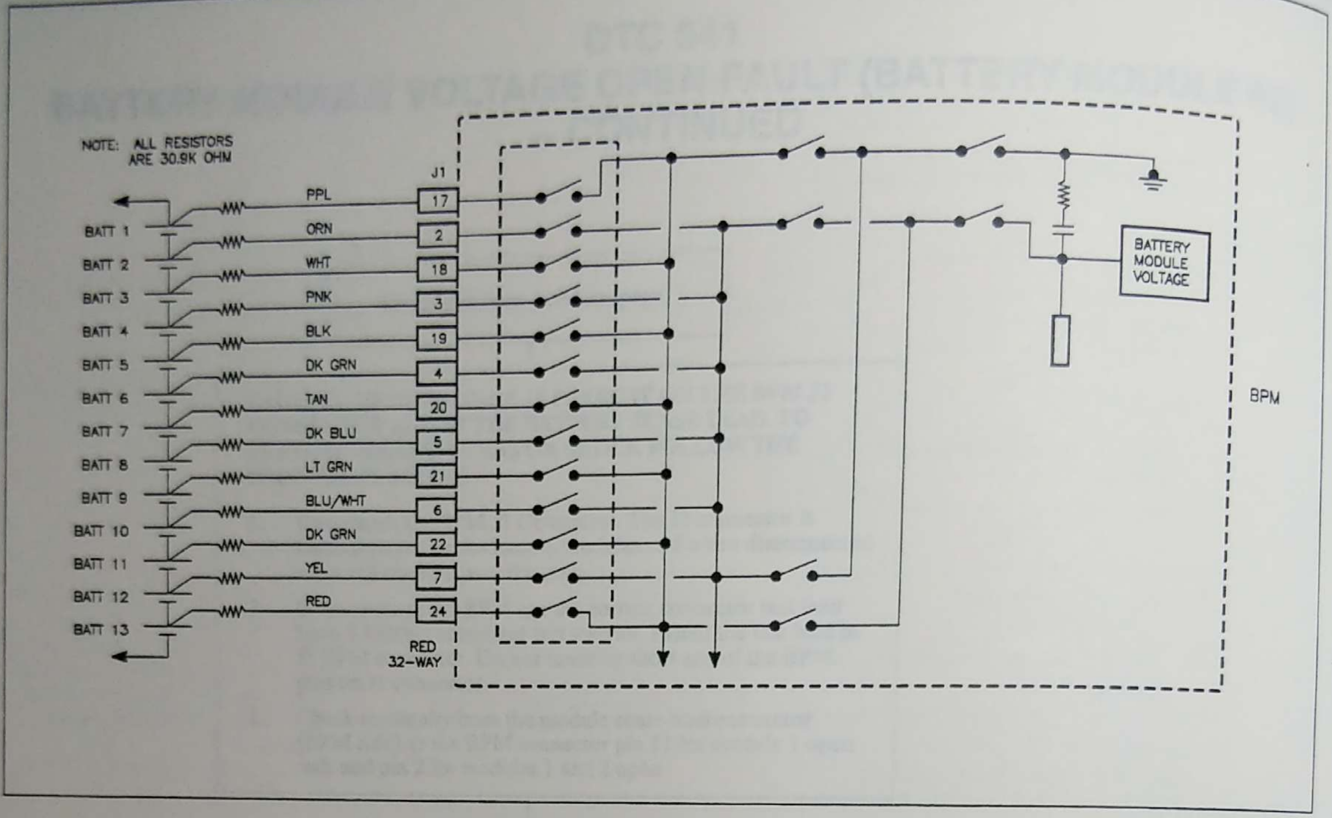
1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

Is continuity present?
No
Repair wire between sense lead connector and BPM.
Yes
Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 043 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #6)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is 0 to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #6: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

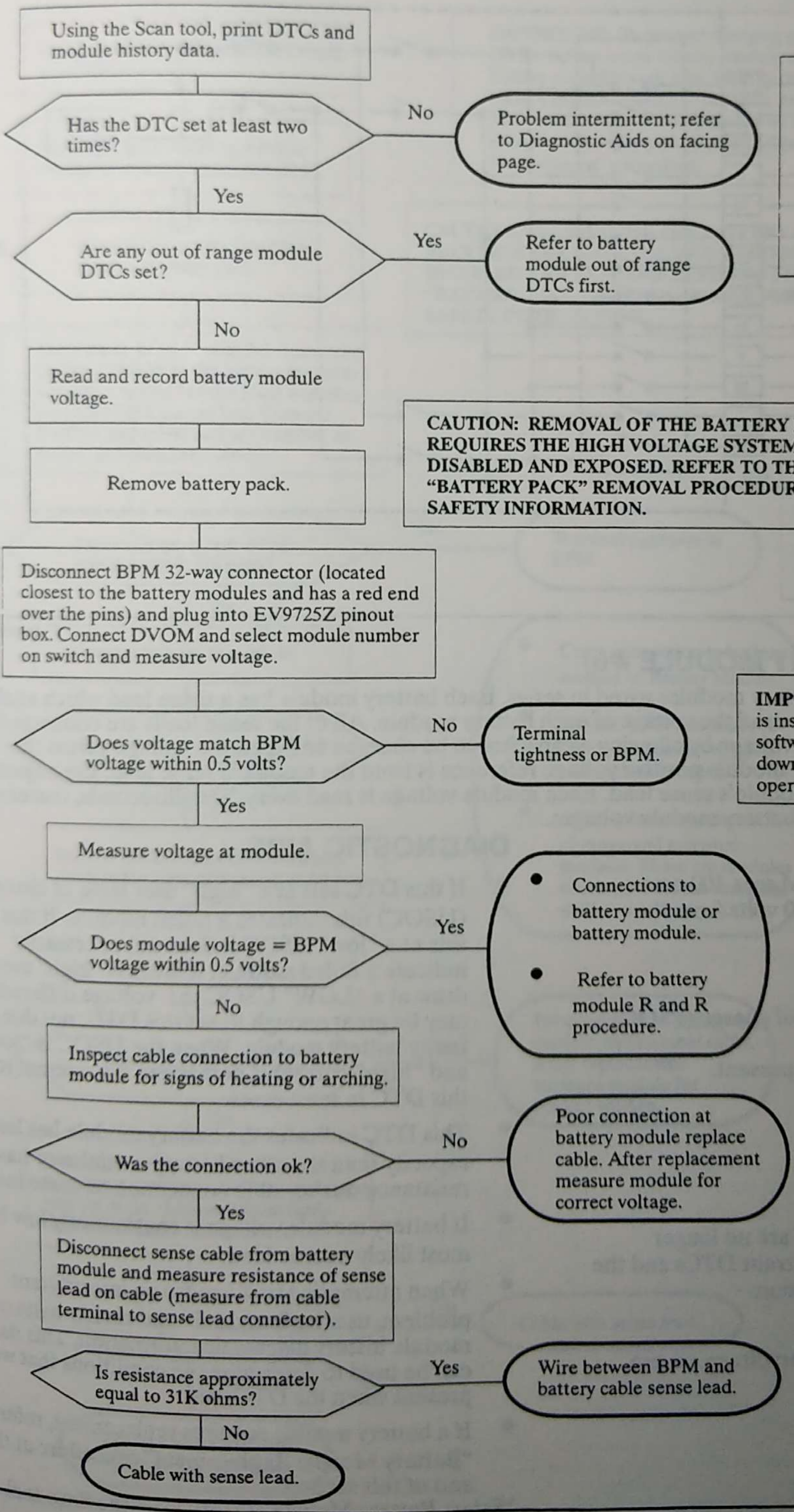
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

DTC 043
MARGINAL (BATTERY MODULE #6)



Using the Scan tool, print DTCs and module history data.

Has the DTC set at least two times?

Problem intermittent; refer to Diagnostic Aids on facing page.

Are any out of range module DTCs set?

Refer to battery module out of range DTCs first.

Read and record battery module voltage.

Remove battery pack.

Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Connections to battery module or battery module.
- Refer to battery module R and R procedure.

Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Poor connection at battery module replace cable. After replacement measure module for correct voltage.

Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).

Is resistance approximately equal to 31K ohms?

Wire between BPM and battery cable sense lead.

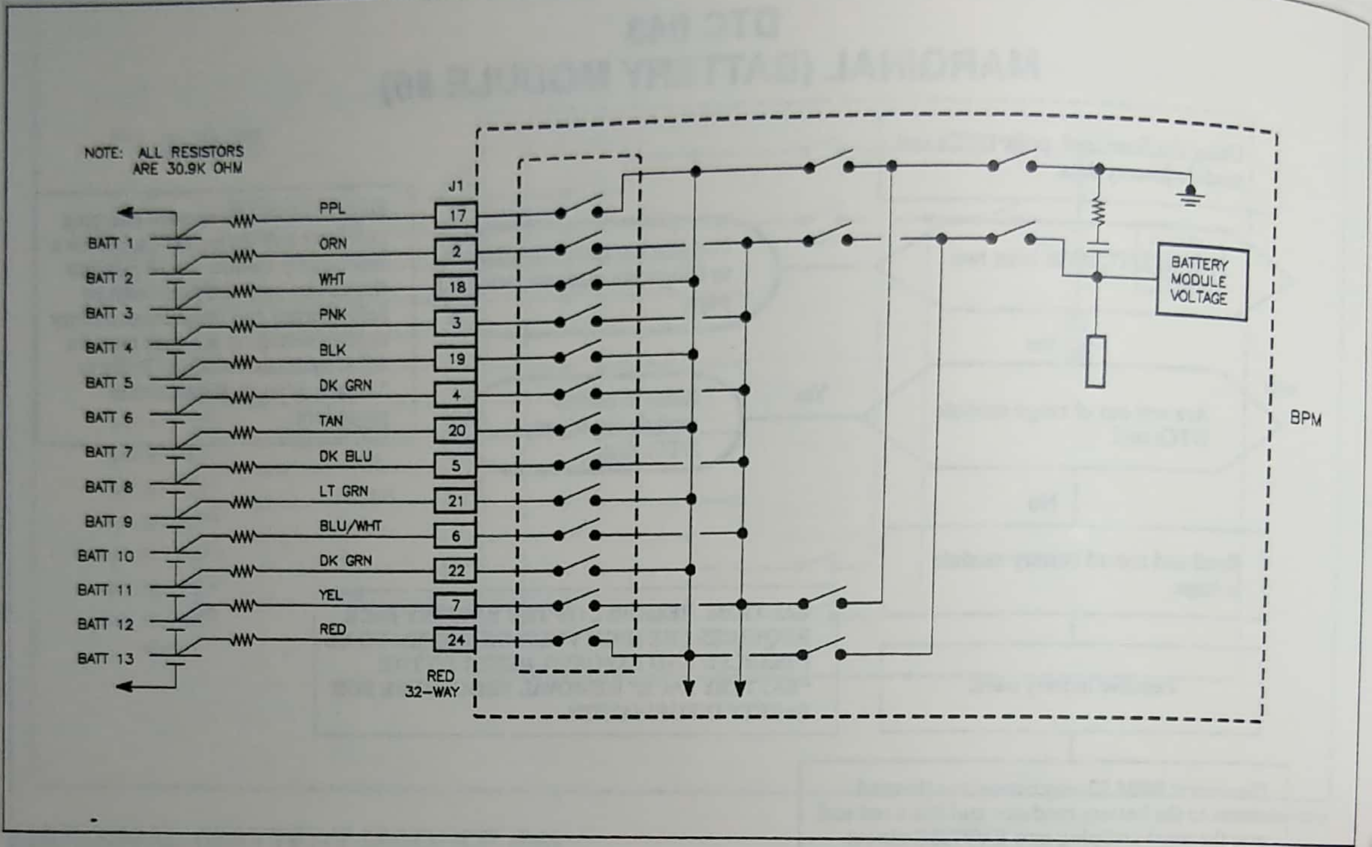
Cable with sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 044 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #6)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is 0 to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #6: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

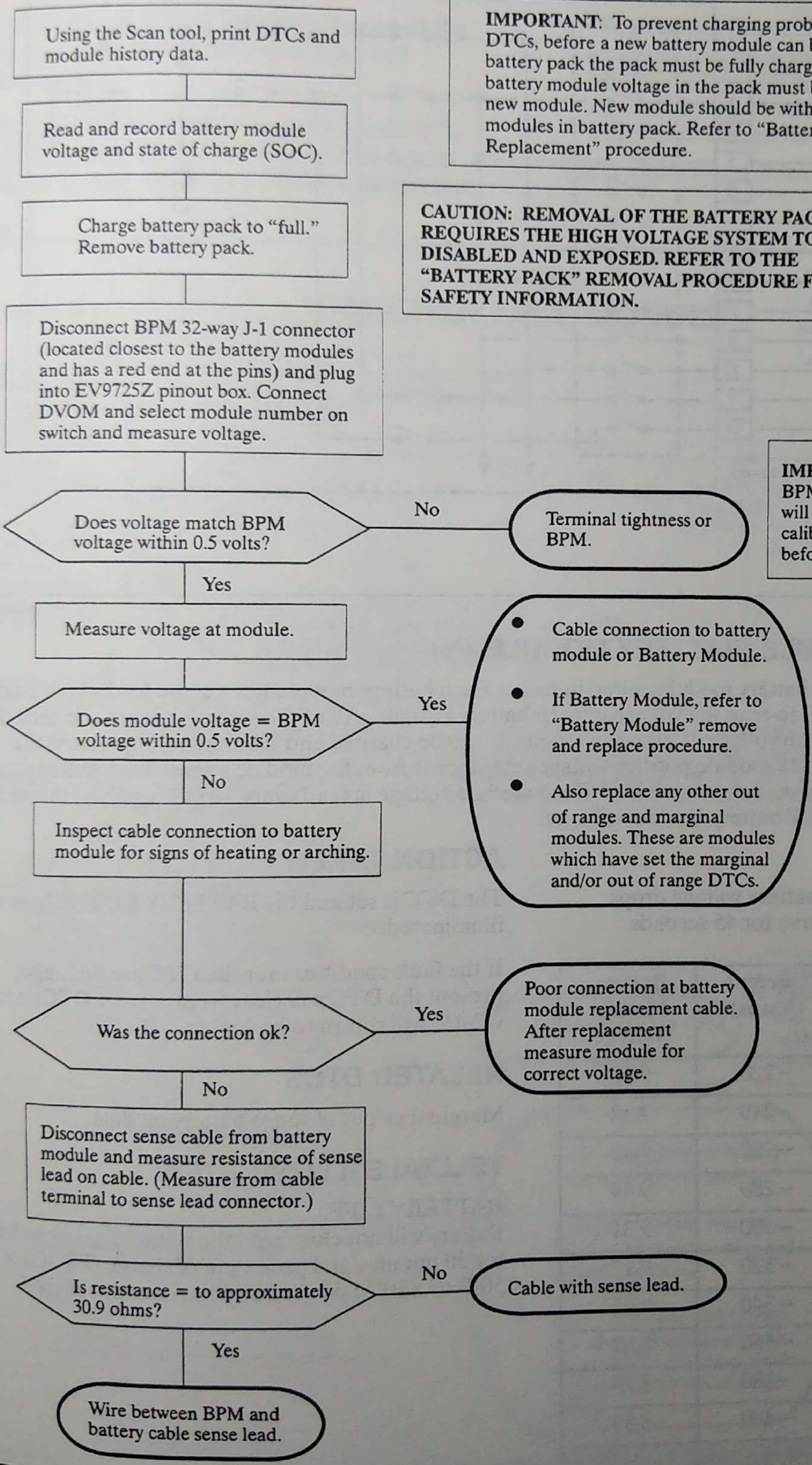
*Select Battery Module History from the Scan tool BPM menu.

DTC 044
OUT OF RANGE (BATTERY MODULE #6)

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.



Using the Scan tool, print DTCs and module history data.

Read and record battery module voltage and state of charge (SOC).

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

No: Terminal tightness or BPM.

Yes: Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

Yes:

- Cable connection to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

No: Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Yes: Poor connection at battery module replacement cable. After replacement measure module for correct voltage.

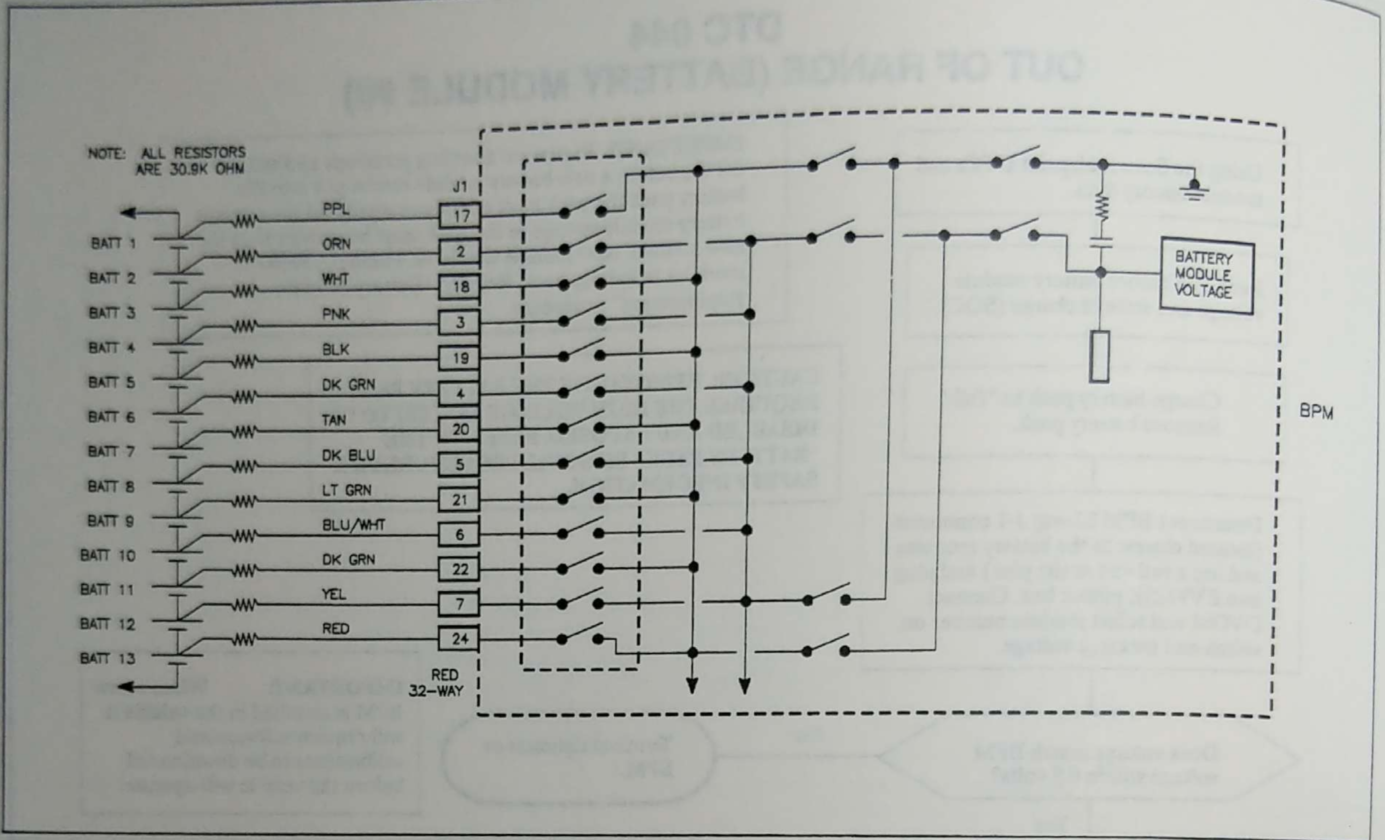
No: Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)

Is resistance = to approximately 30.9 ohms?

No: Cable with sense lead.

Yes: Wire between BPM and battery cable sense lead.

DTC 045 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
J1
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #6)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage	Current (Amps)	Battery Module Voltage
0	11.75	−220	9.60
−20	11.10	−240	9.52
−40	10.90	−260	9.48
−60	10.65	−280	9.44
−80	10.45	−300	9.31
−100	10.30	−320	9.17
−120	10.15	−340	9.03
−140	10.00	−360	8.87
−160	9.90	−380	8.73
−180	9.80	−400	8.59
−200	9.70		

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

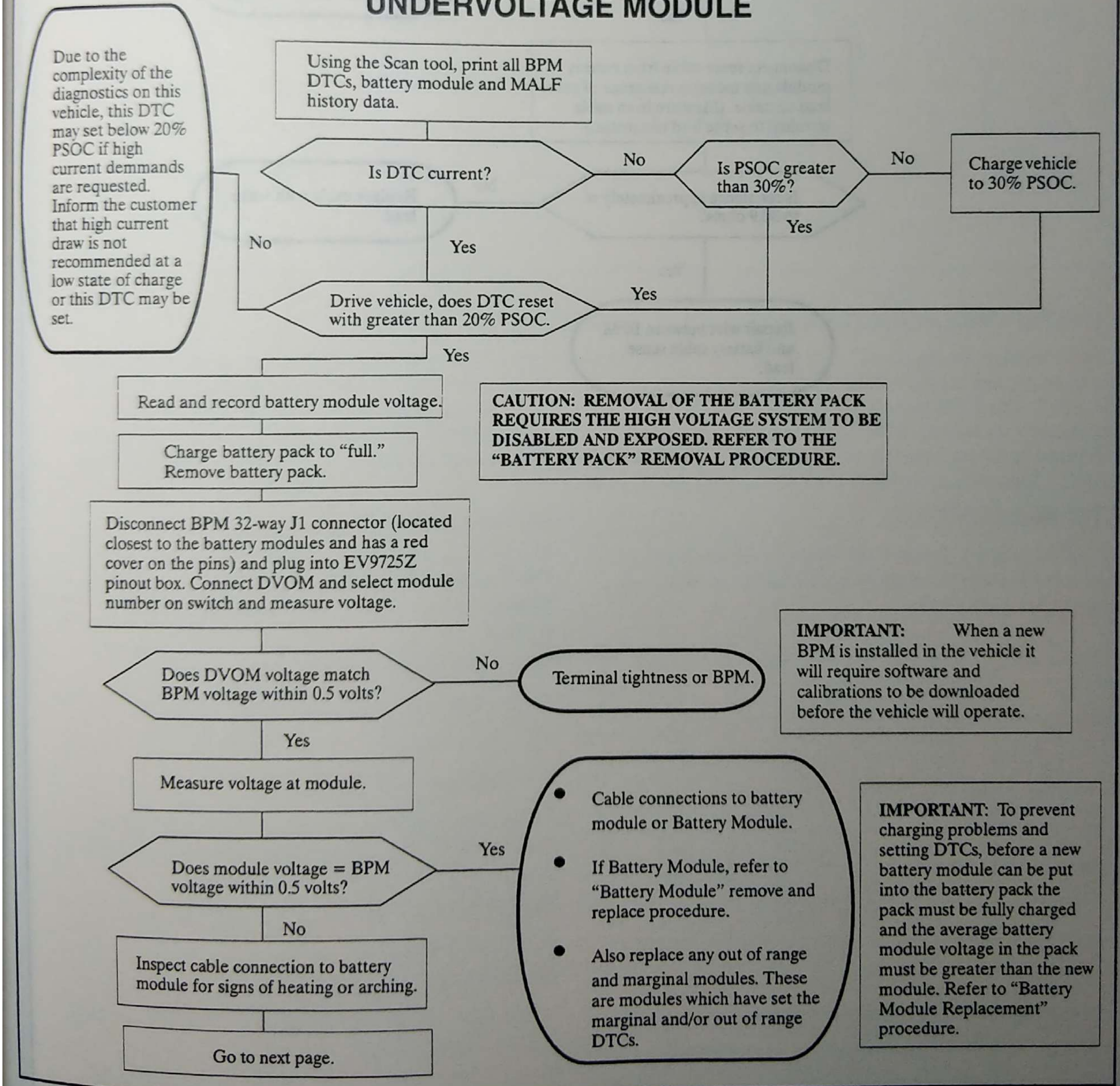
BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below 0% user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 045
UNDERVOLTAGE MODULE


Using the Scan tool, print all BPM DTCs, battery module and MALF history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
Yes
No
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
Cable connections to battery module or Battery Module.
If Battery Module, refer to "Battery Module" remove and replace procedure.
Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

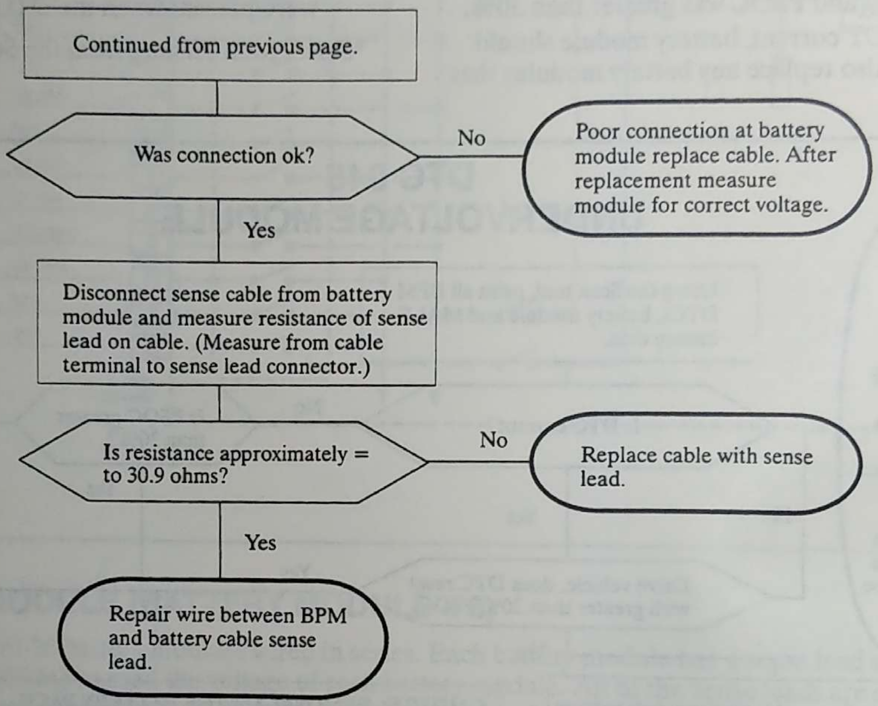
Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

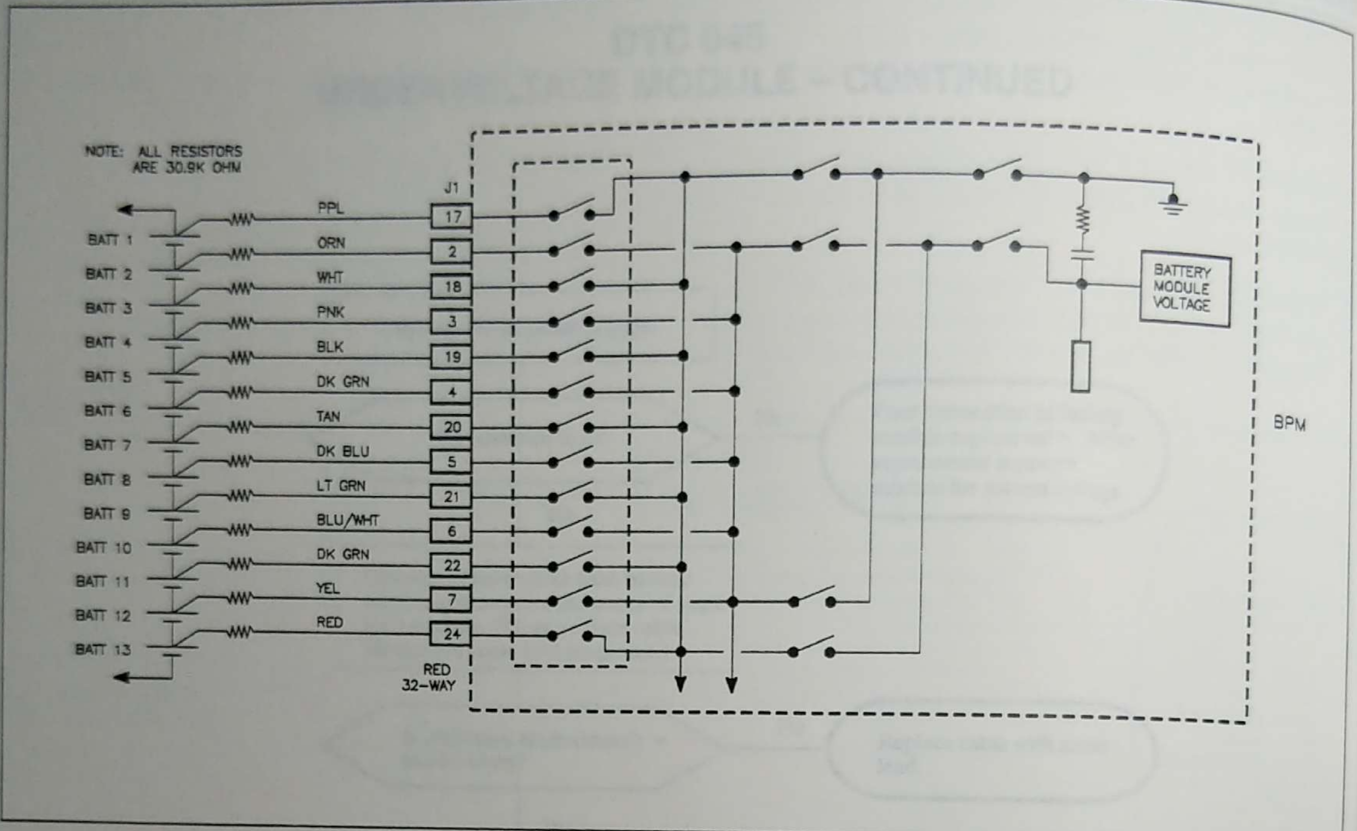
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 045
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 046 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
J1
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #6)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

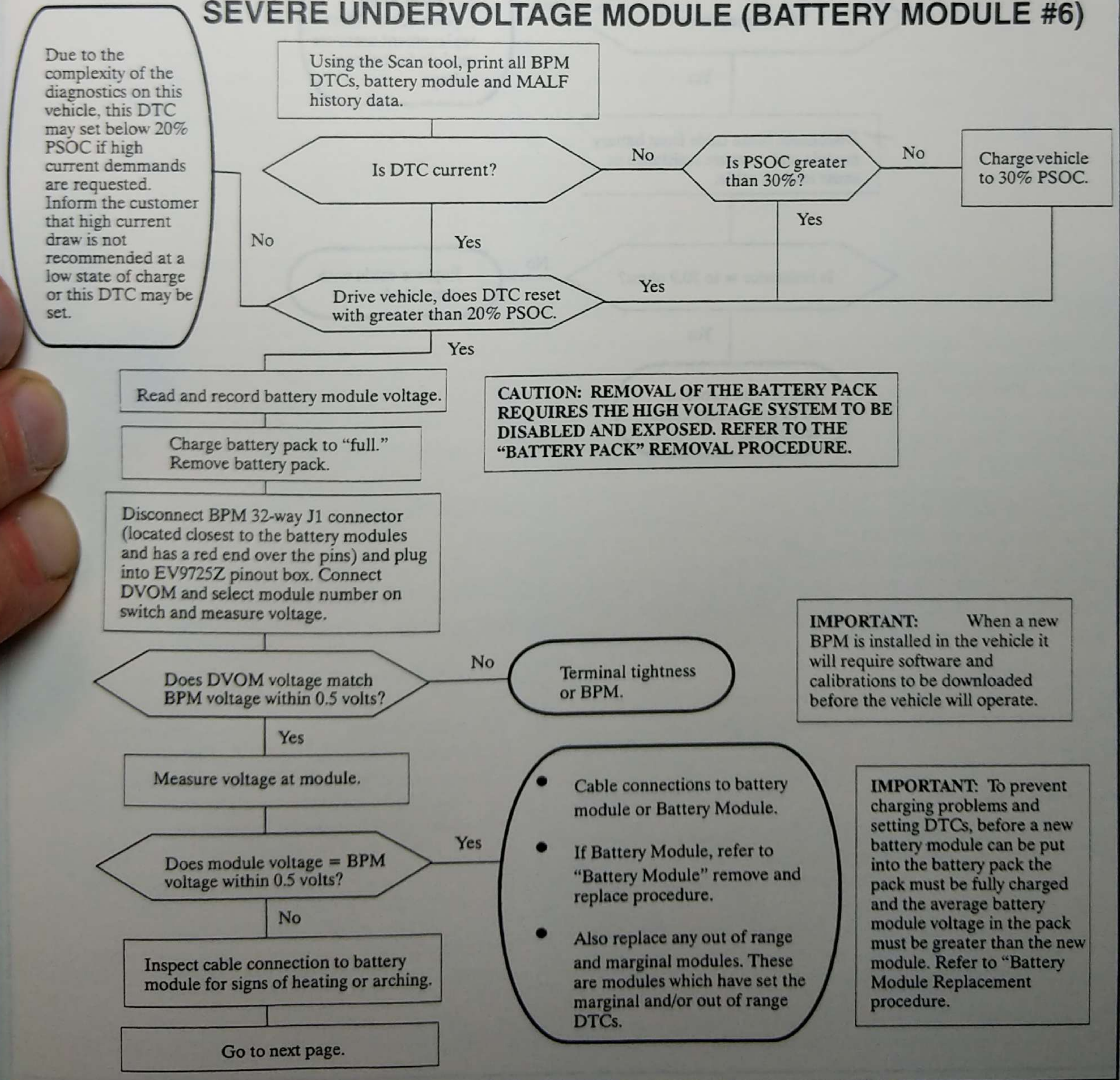
Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches 0% user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 046
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #6)


Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

Using the Scan tool, print all BPM DTCs, battery module and MALF history data.

Is DTC current?

Is PSOC greater than 30%?

Charge vehicle to 30% PSOC.

Drive vehicle, does DTC reset with greater than 20% PSOC.

Read and record battery module voltage.

Charge battery pack to "full." Remove battery pack.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

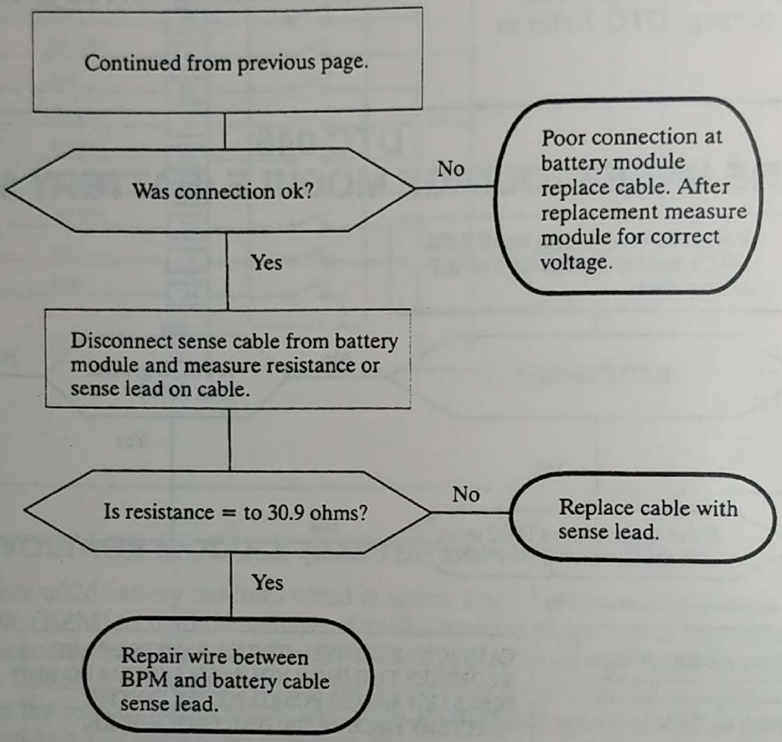
- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement procedure.

Inspect cable connection to battery module for signs of heating or arching.

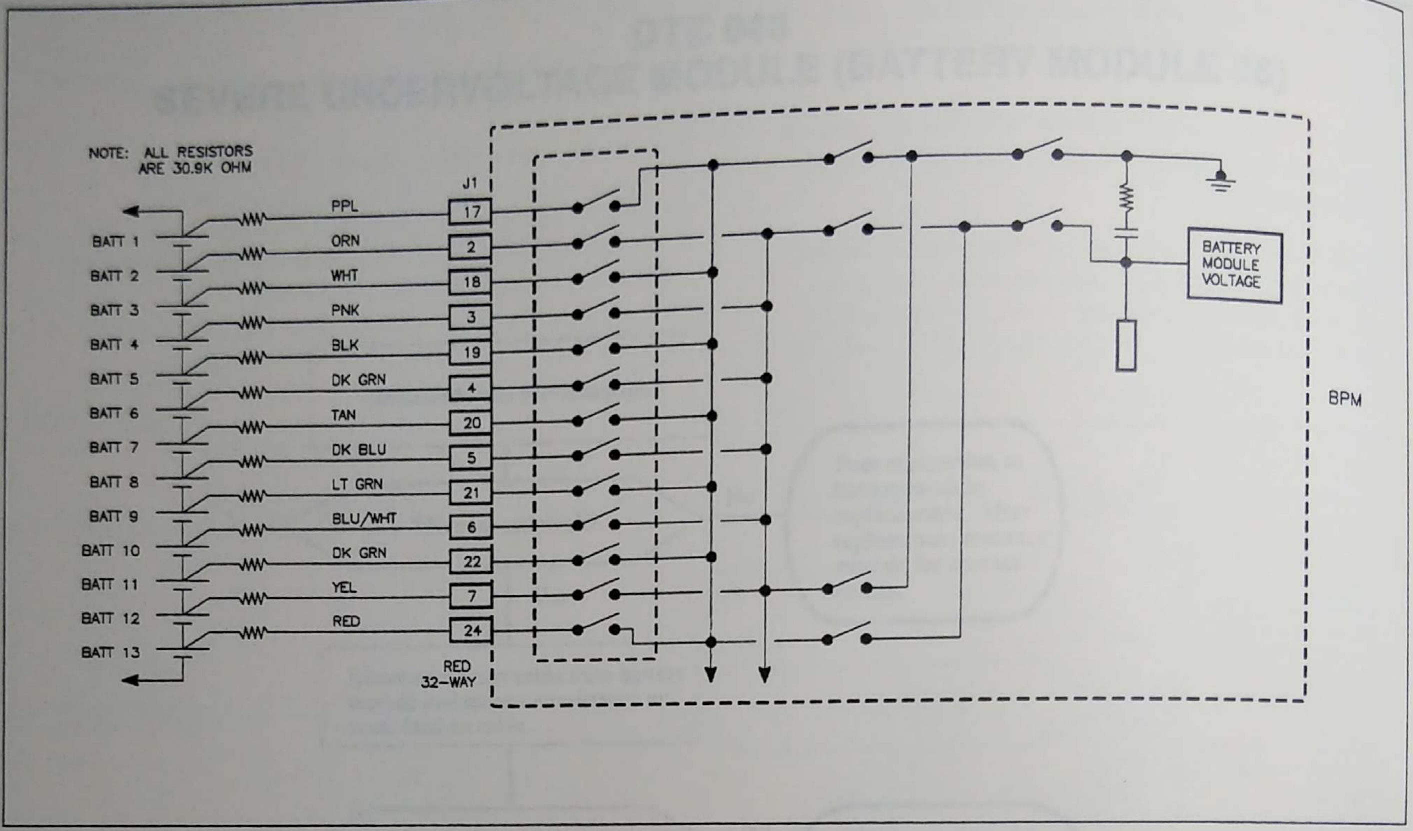
Go to next page.

DTC 046
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #6)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 047 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #6)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

SERVICE NOW and REDUCED PERFORMANCE

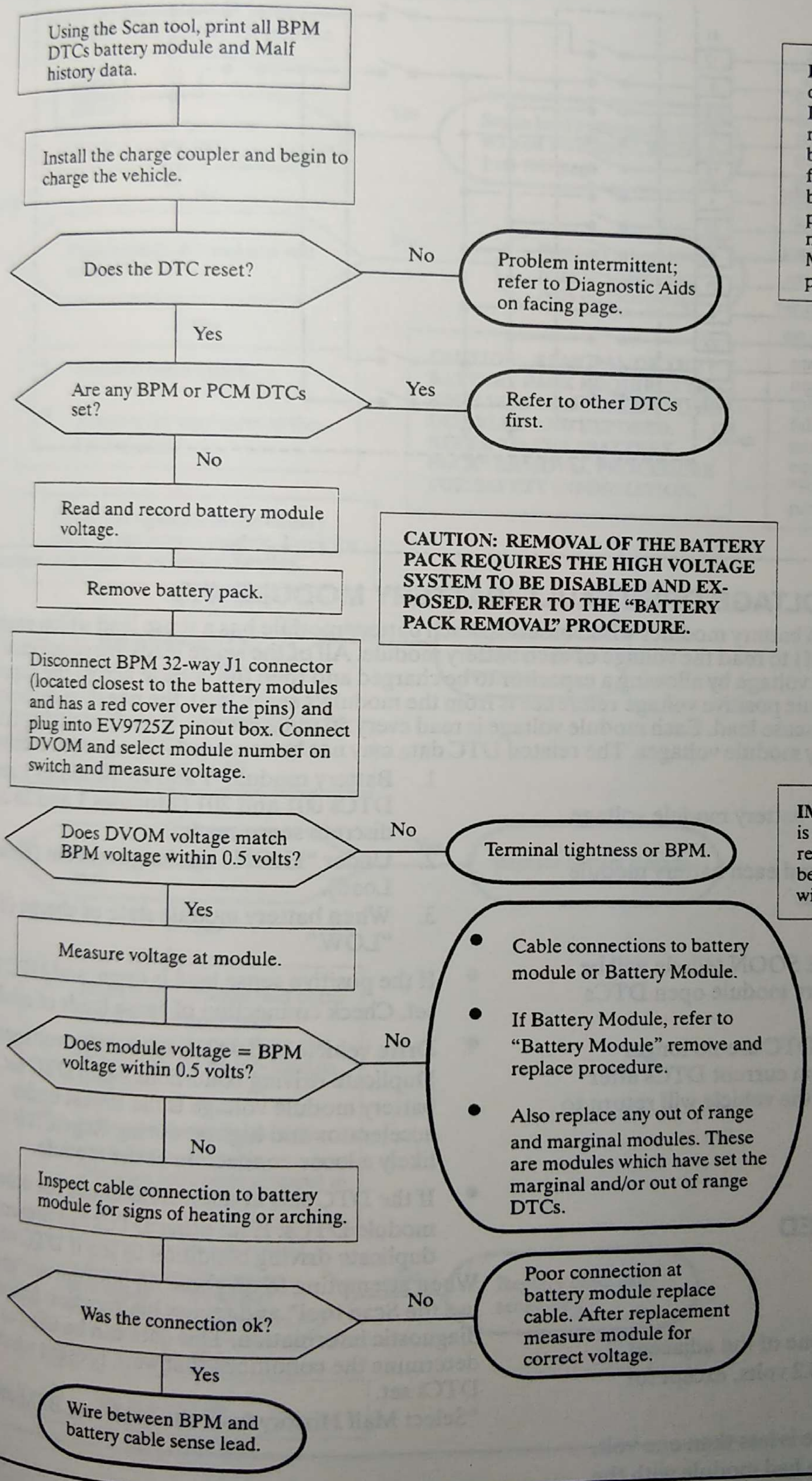
DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

CS CamScanner

DTC 047
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #6)

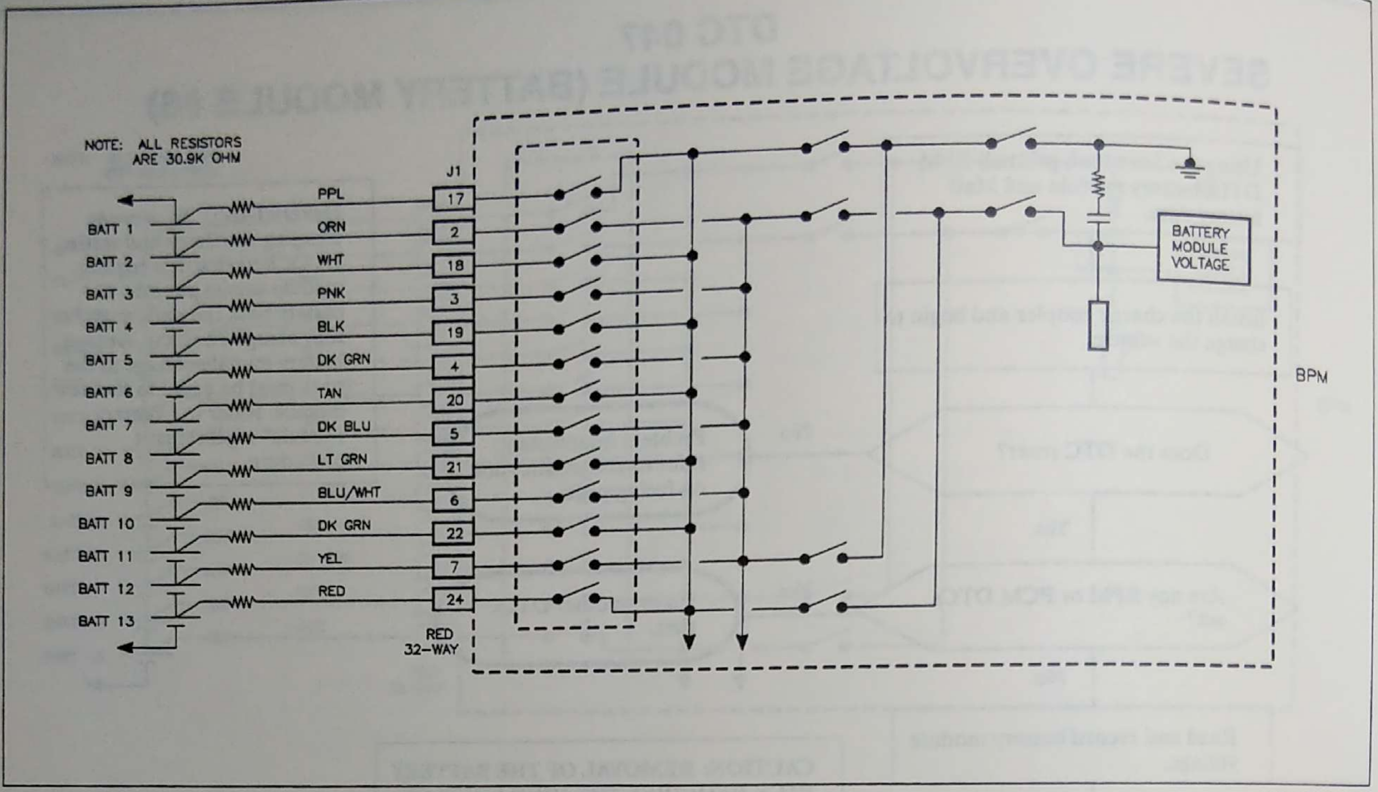

Using the Scan tool, print all BPM DTCs battery module and Malf history data.
Install the charge coupler and begin to charge the vehicle.
Does the DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any BPM or PCM DTCs set?
Yes
Refer to other DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
No
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 049 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #7)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

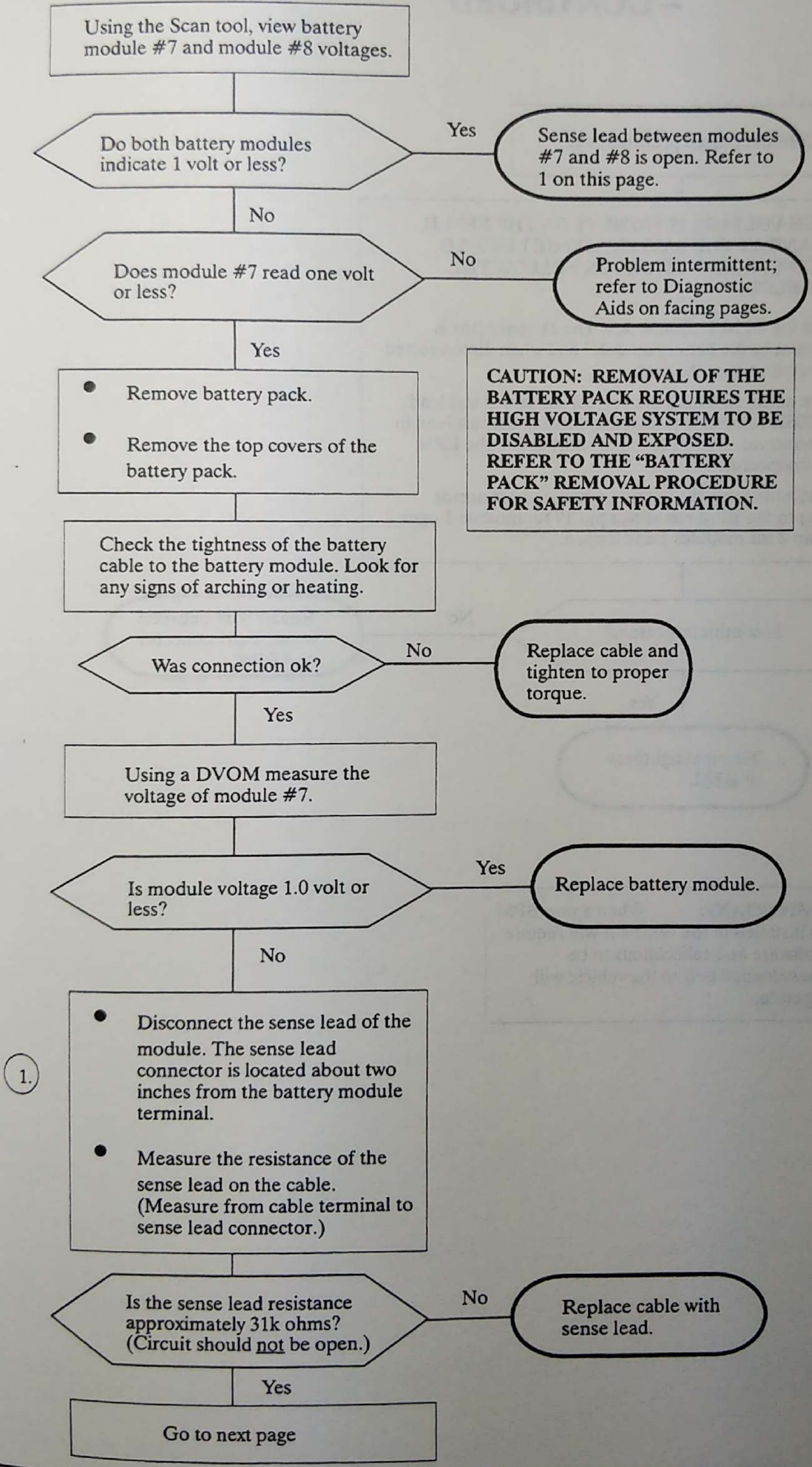
DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:
  1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
  2. Under “HIGH” discharge current (Heavy Load).
  3. When battery module state of charge (SOC) is “LOW.”
- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 049
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #7)

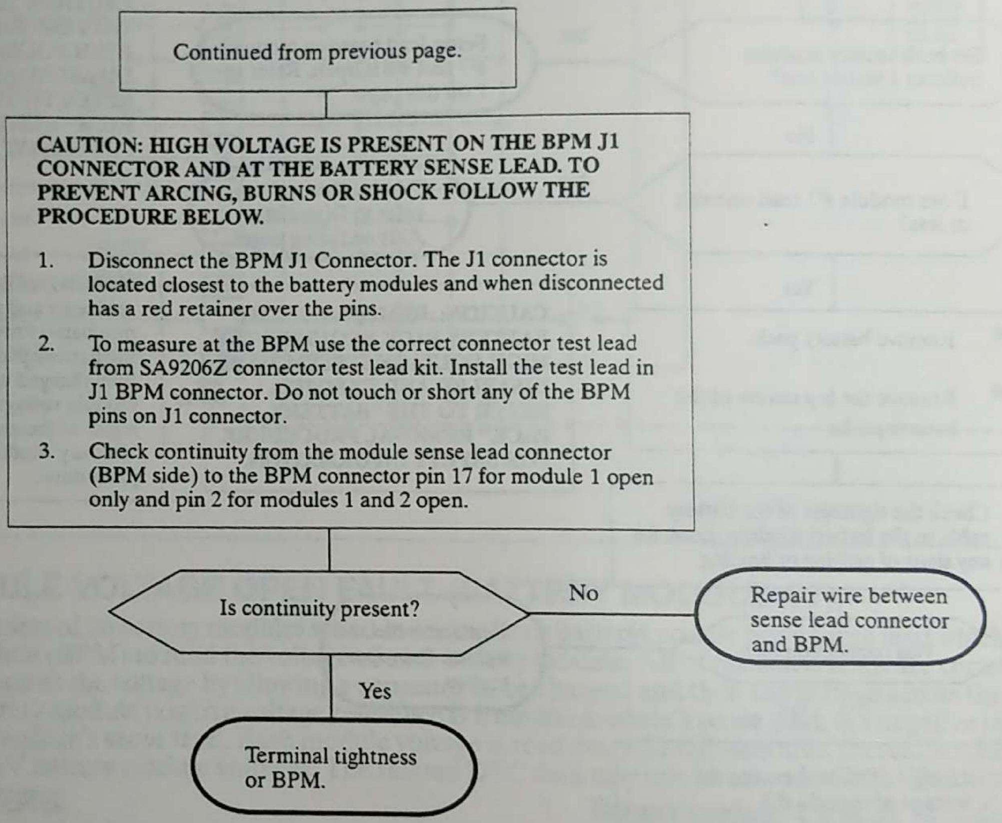

Using the Scan tool, view battery module #7 and module #8 voltages.
Do both battery modules indicate 1 volt or less?
Yes
Sense lead between modules #7 and #8 is open. Refer to 1 on this page.
No
Does module #7 read one volt or less?
No
Problem intermittent; refer to Diagnostic Aids on facing pages.
Yes
Remove battery pack.
Remove the top covers of the battery pack.
Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.
Was connection ok?
No
Replace cable and tighten to proper torque.
Yes
Using a DVOM measure the voltage of module #7.
Is module voltage 1.0 volt or less?
Yes
Replace battery module.
No
1.
Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)
Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)
No
Replace cable with sense lead.
Yes
Go to next page

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 049
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #7) – CONTINUED


Continued from previous page.
Is continuity present?
No
Repair wire between sense lead connector and BPM.
Yes
Terminal tightness or BPM.

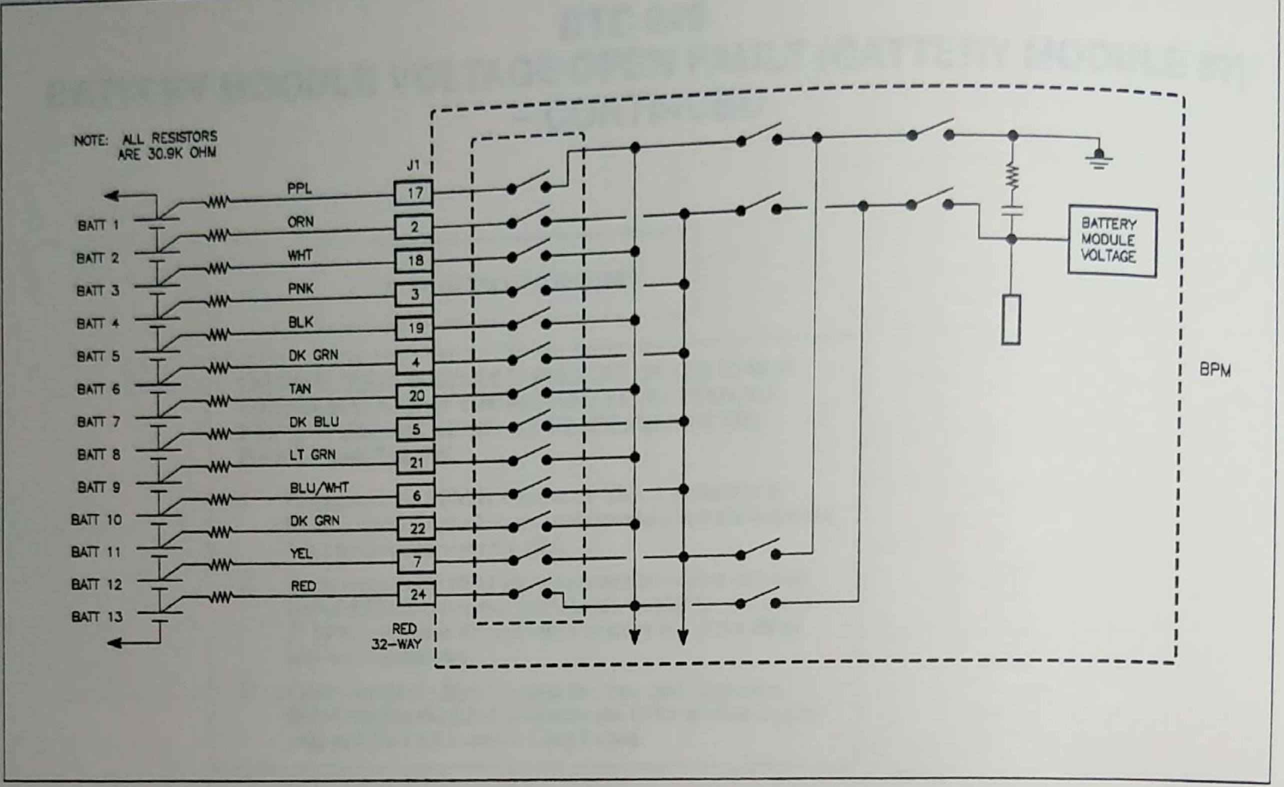
CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 051 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #7)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is 0 to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #7: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

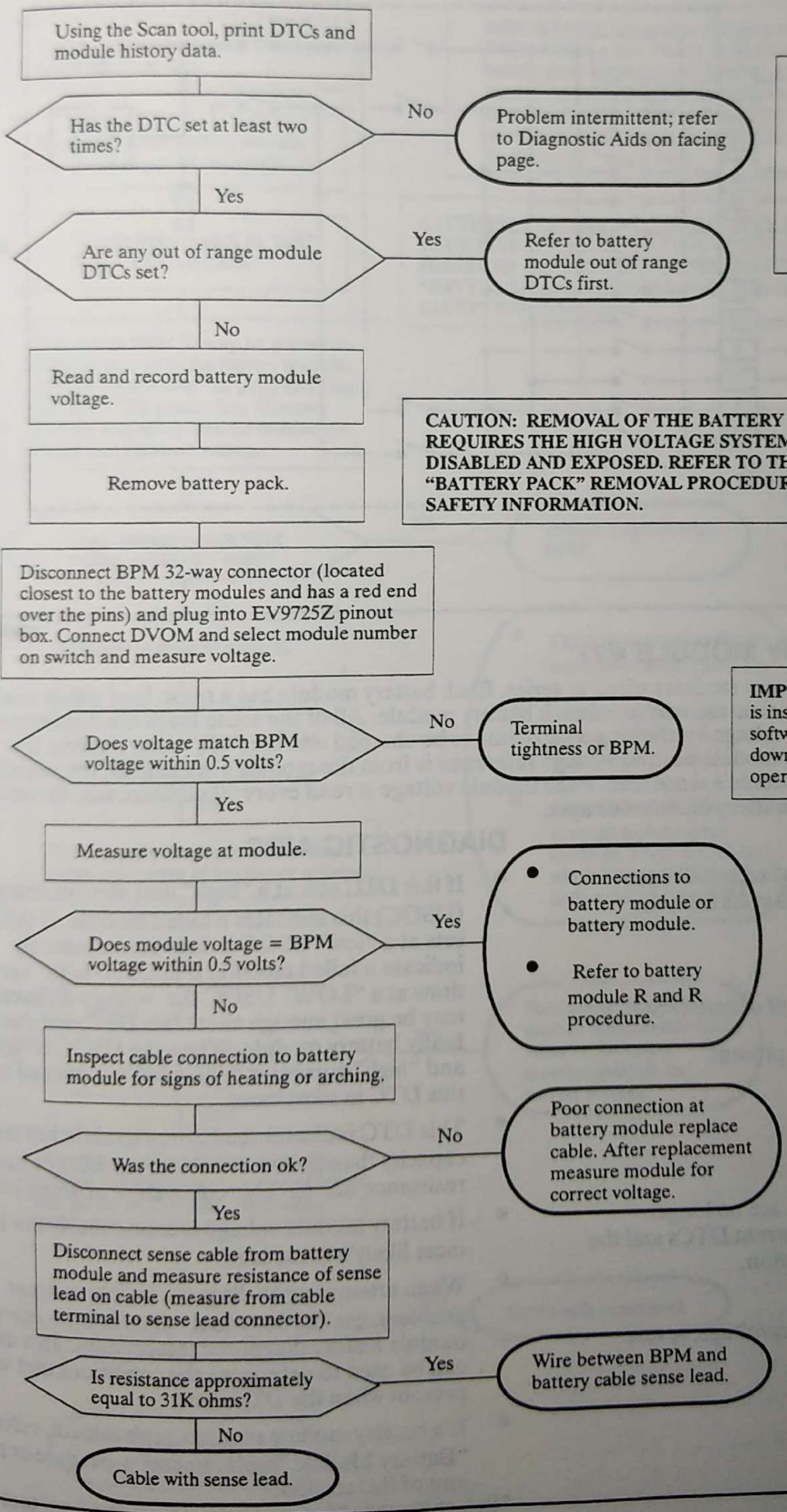
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

DTC 051
MARGINAL (BATTERY MODULE #7)



Using the Scan tool, print DTCs and module history data.

Has the DTC set at least two times?

Problem intermittent; refer to Diagnostic Aids on facing page.

Are any out of range module DTCs set?

Refer to battery module out of range DTCs first.

Read and record battery module voltage.

Remove battery pack.

Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Connections to battery module or battery module.
- Refer to battery module R and R procedure.

Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Poor connection at battery module replace cable. After replacement measure module for correct voltage.

Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).

Is resistance approximately equal to 31K ohms?

Wire between BPM and battery cable sense lead.

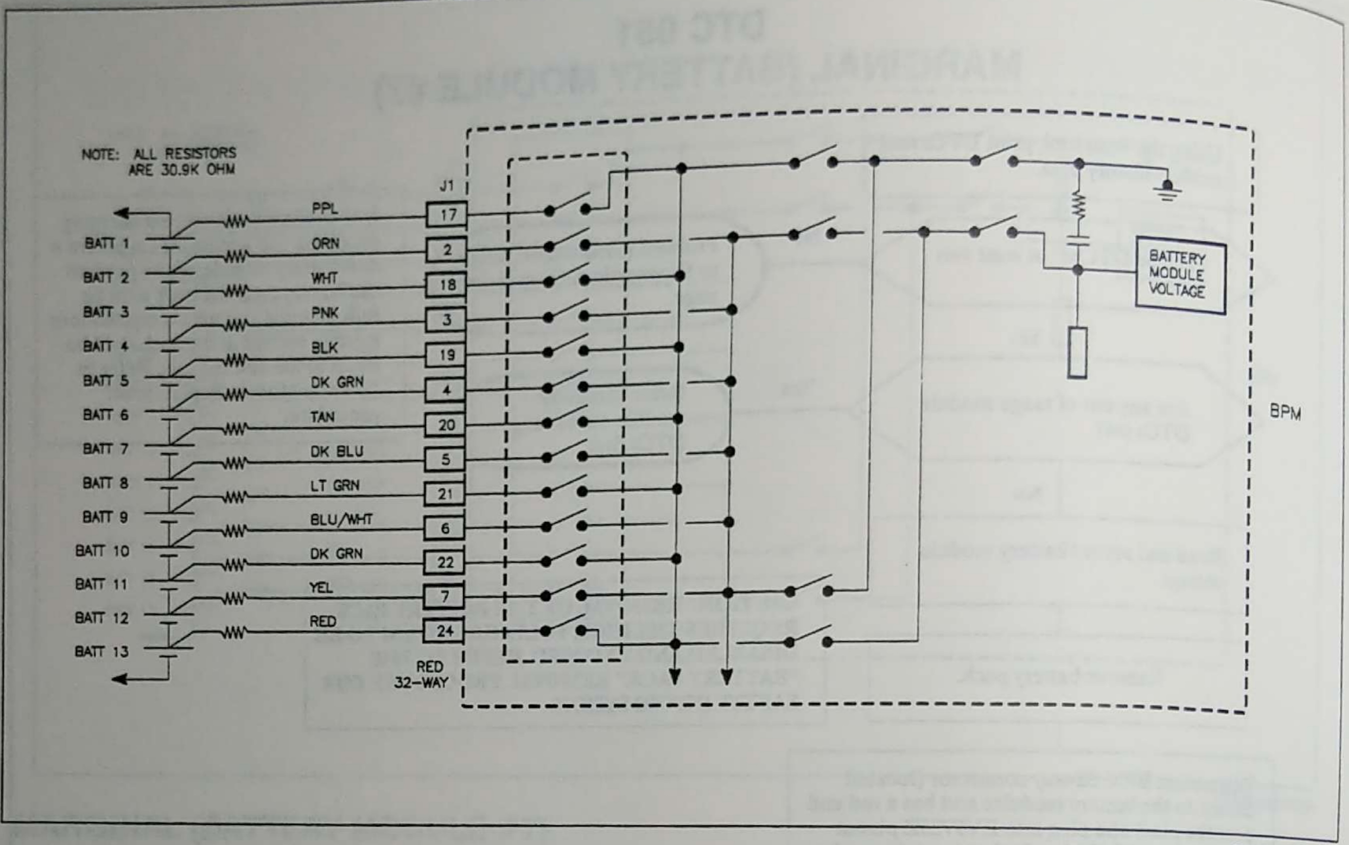
Cable with sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 052 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #7)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is 0 to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #7: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

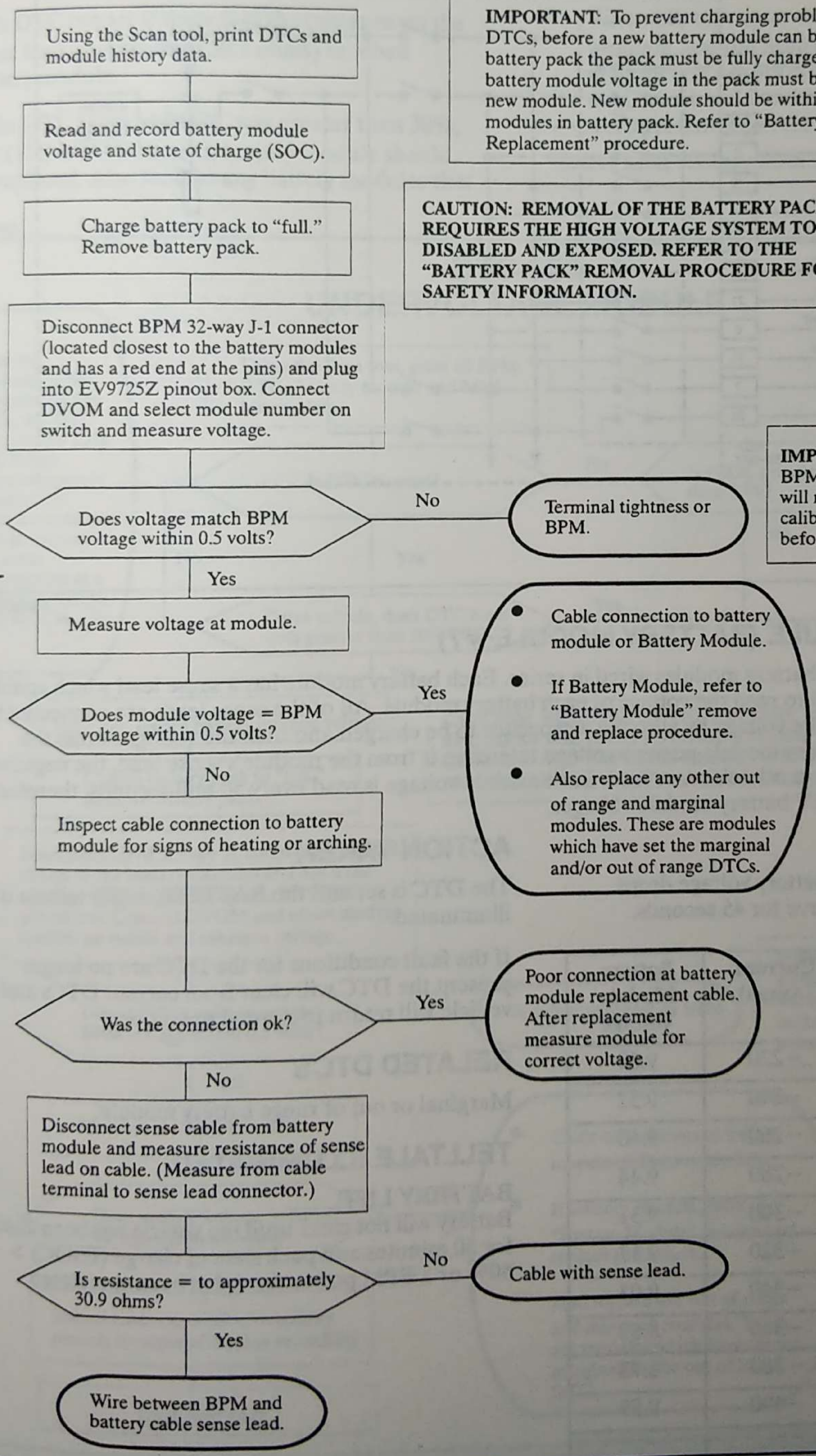
*Select Battery Module History from the Scan tool BPM menu.

DTC 052
OUT OF RANGE (BATTERY MODULE #7)

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.



Using the Scan tool, print DTCs and module history data.

Read and record battery module voltage and state of charge (SOC).

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Cable connection to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Poor connection at battery module replacement cable. After replacement measure module for correct voltage.

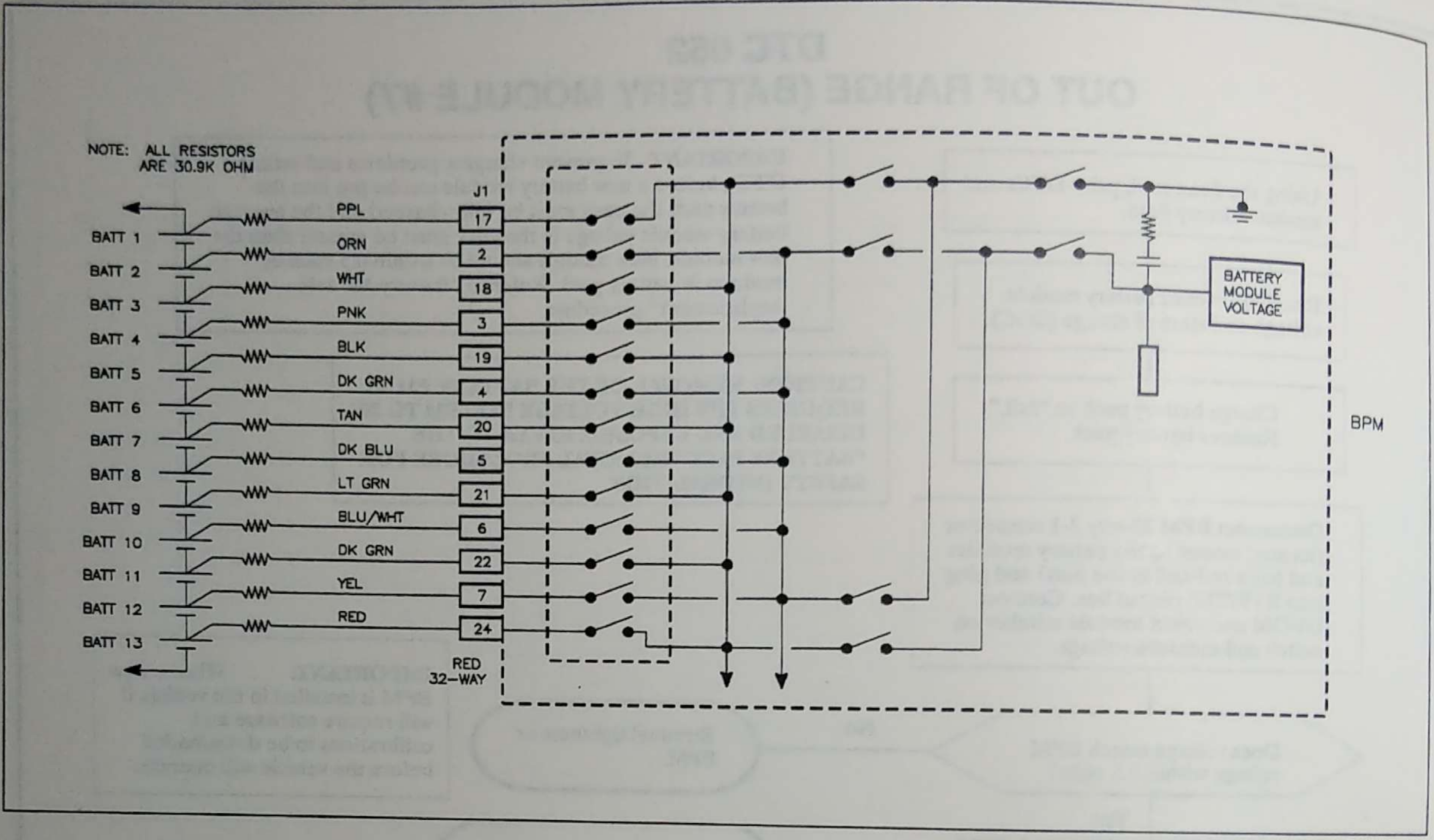
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)

Is resistance = to approximately 30.9 ohms?

Cable with sense lead.

Wire between BPM and battery cable sense lead.

DTC 053 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED
32–WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #7)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage	Current (Amps)	Battery Module Voltage
0	11.75	−220	9.60
−20	11.10	−240	9.52
−40	10.90	−260	9.48
−60	10.65	−280	9.44
−80	10.45	−300	9.31
−100	10.30	−320	9.17
−120	10.15	−340	9.03
−140	10.00	−360	8.87
−160	9.90	−380	8.73
−180	9.80	−400	8.59
−200	9.70		

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

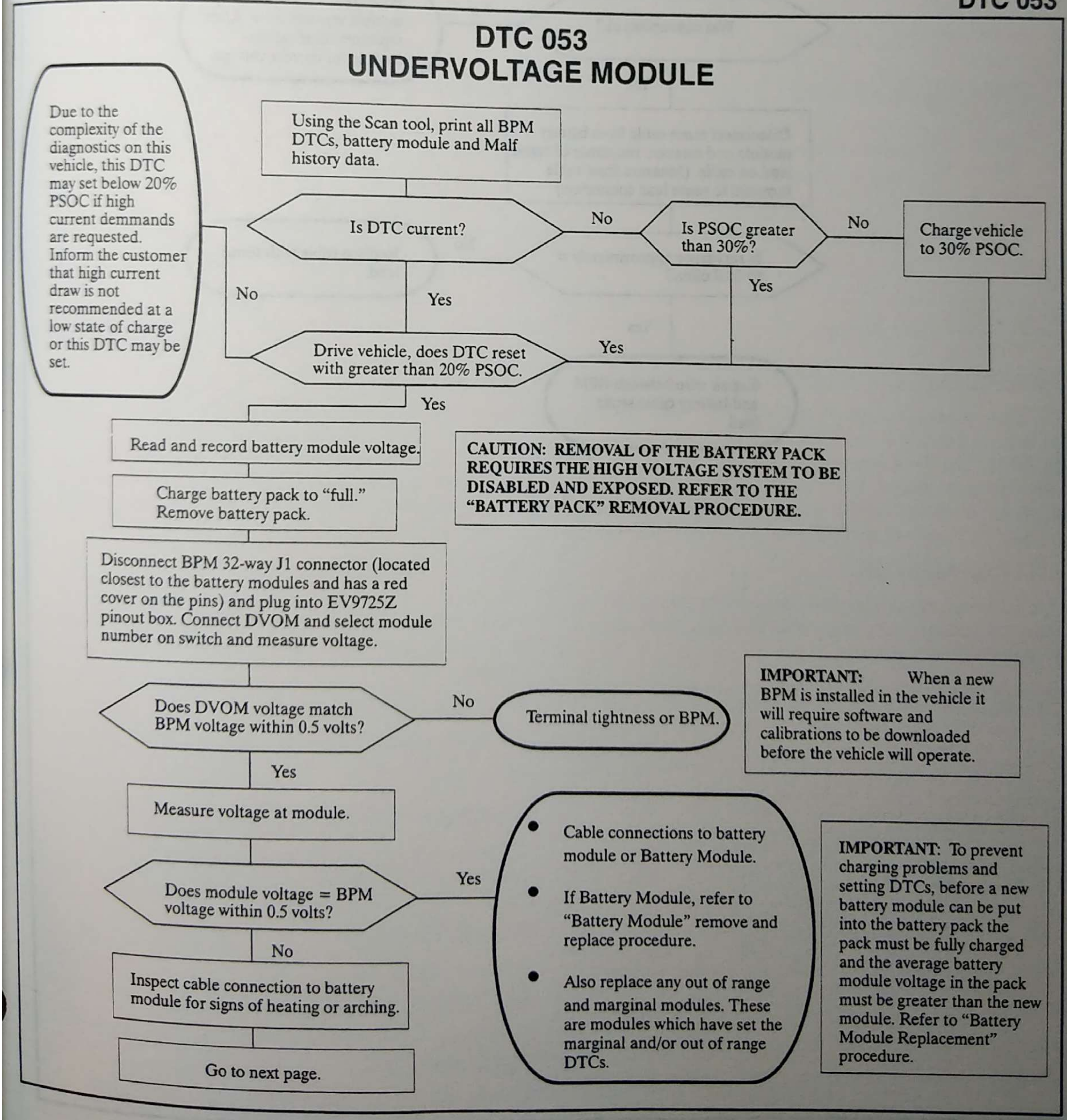
DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below 0% user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 053

DTC 053
UNDERVOLTAGE MODULE

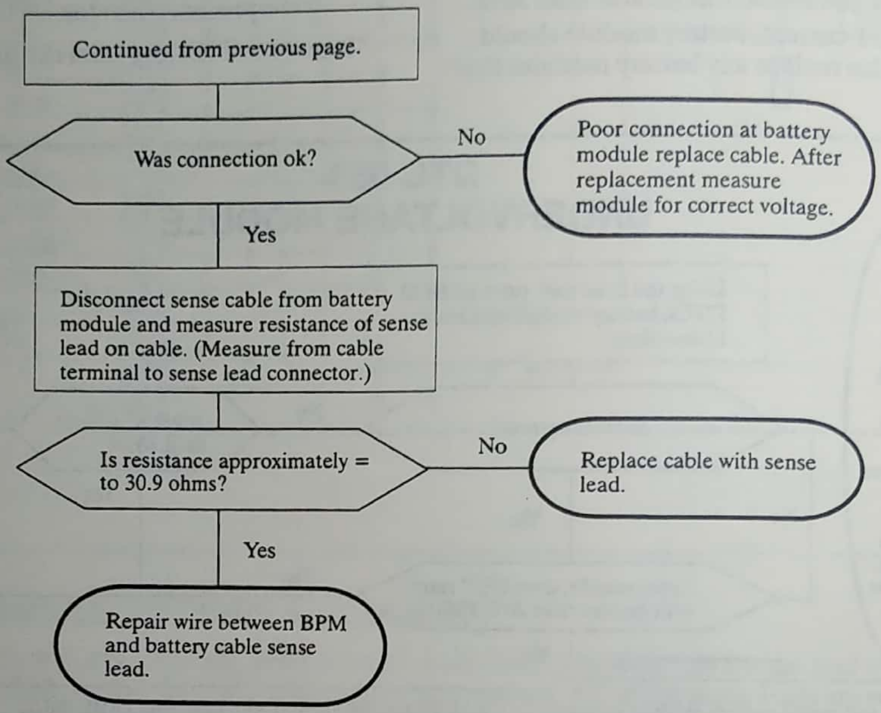

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
Yes
No
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
Cable connections to battery module or Battery Module.
If Battery Module, refer to "Battery Module" remove and replace procedure.
Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

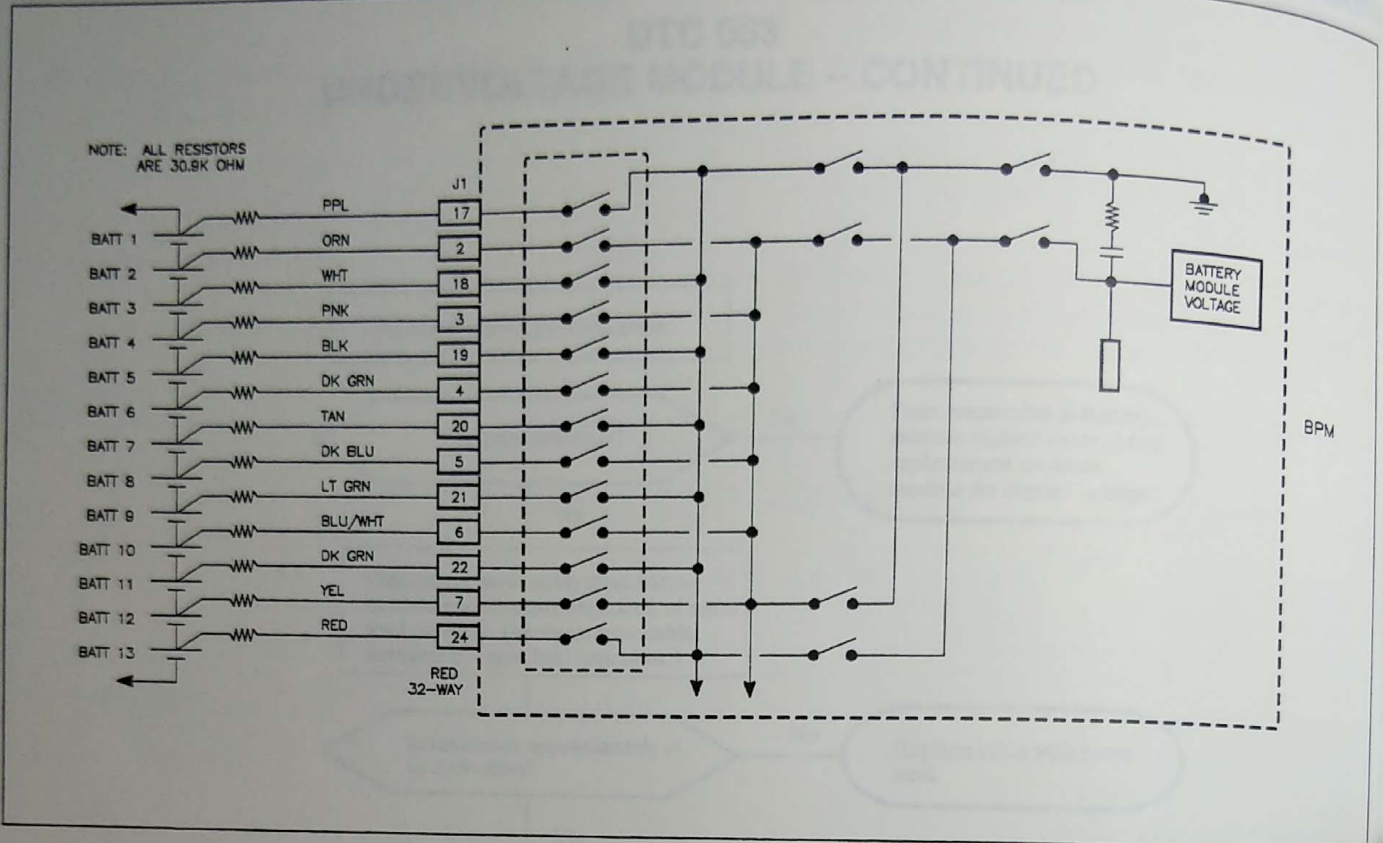
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 053
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 054 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
J1
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #7)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage
0	11.45
-20	10.55
-40	10.20
-60	9.95
-80	9.75
-100	9.60
-120	9.45
-140	9.30
-160	9.20
-180	9.10
-200	9.00
-220	8.90
-240	8.82
-260	8.78
-280	8.74
-300	8.70
-320	8.66
-340	8.58
-360	8.43
-380	8.28
-400	8.14

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

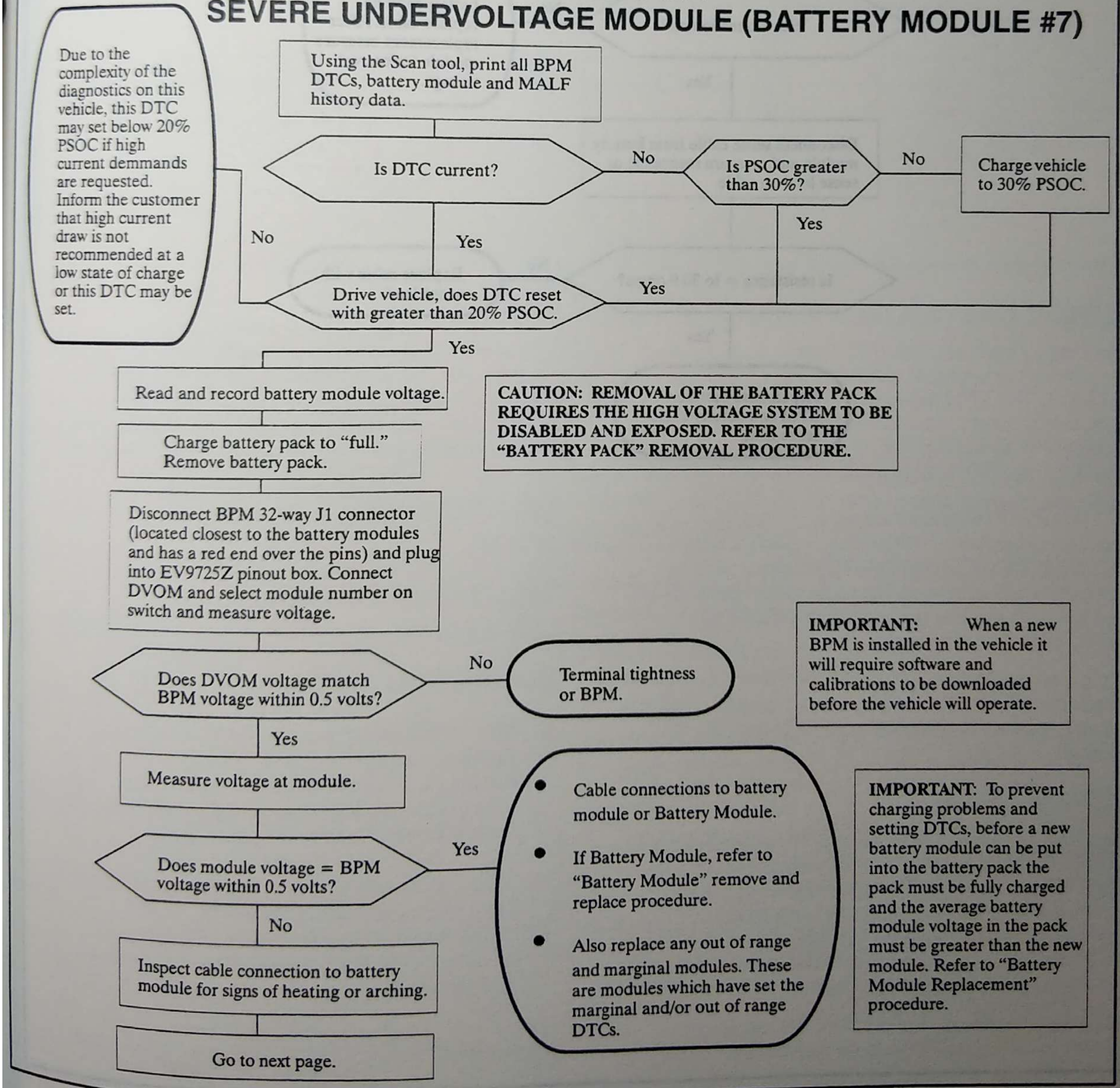
CS CamScanner

DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches 0% user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 054
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #7)


Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and MALF history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
Cable connections to battery module or Battery Module.
If Battery Module, refer to "Battery Module" remove and replace procedure.
Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

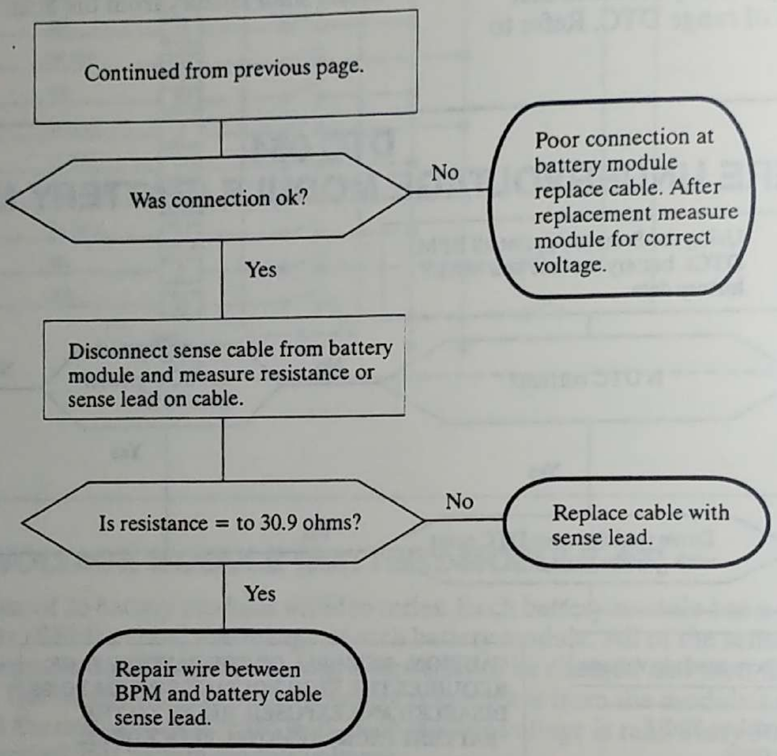
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

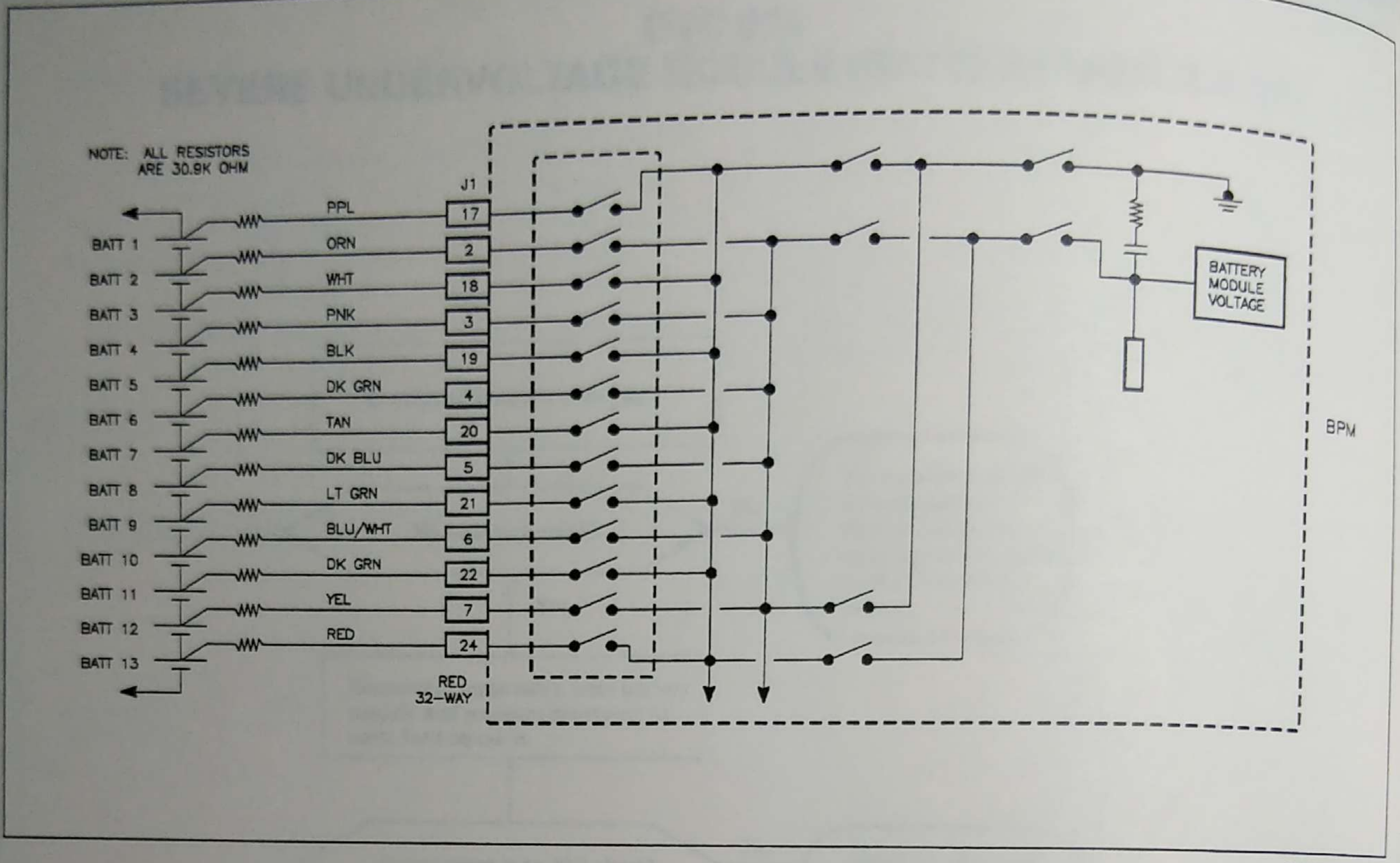
DTC 054

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #7)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance on sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 055 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #7)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

SERVICE NOW and REDUCED PERFORMANCE

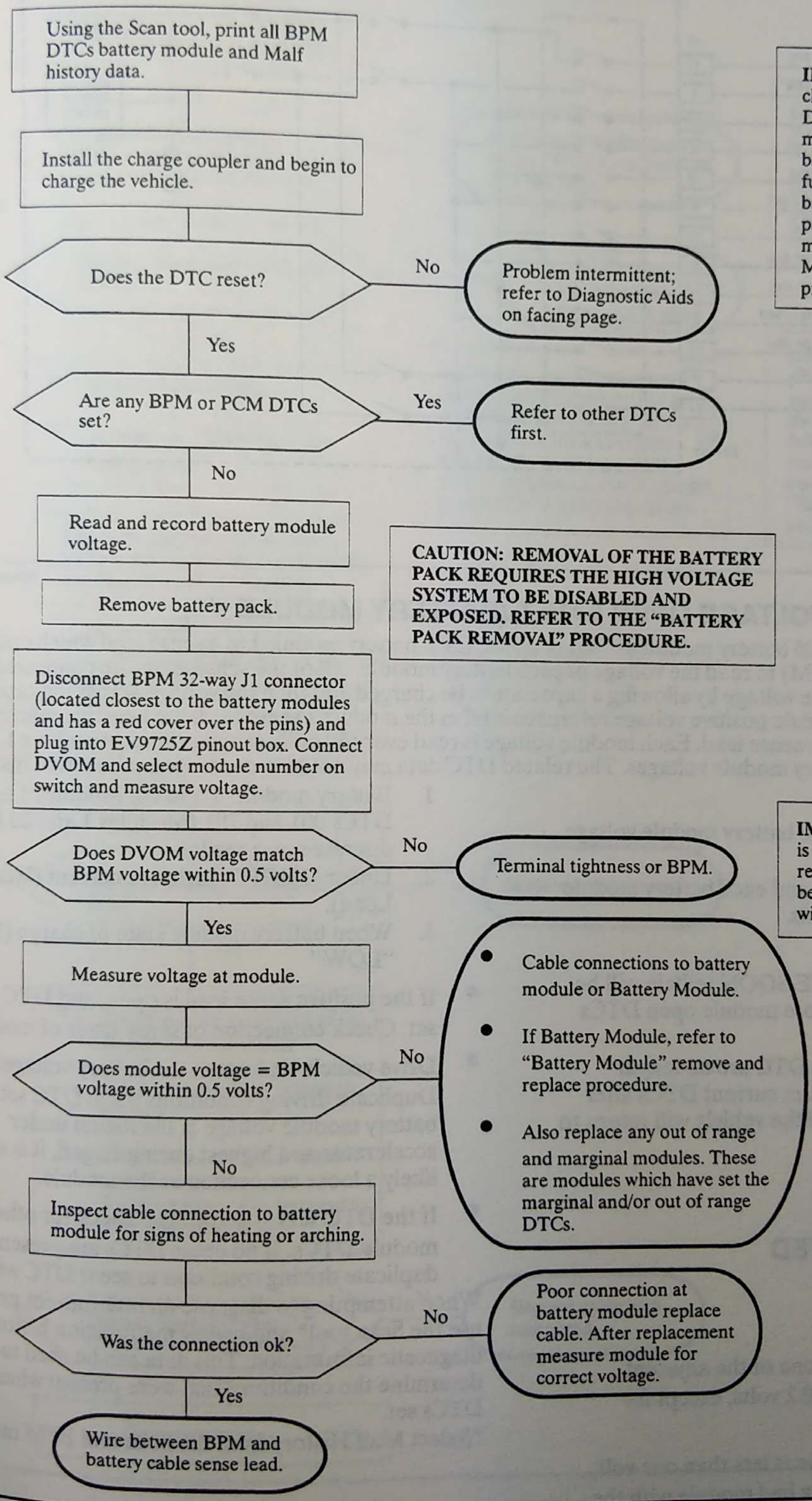
DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

DTC 055
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #7)

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.



Using the Scan tool, print all BPM DTCs battery module and Malf history data.

Install the charge coupler and begin to charge the vehicle.

Does the DTC reset?

Problem intermittent; refer to Diagnostic Aids on facing page.

Are any BPM or PCM DTCs set?

Refer to other DTCs first.

Read and record battery module voltage.

Remove battery pack.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

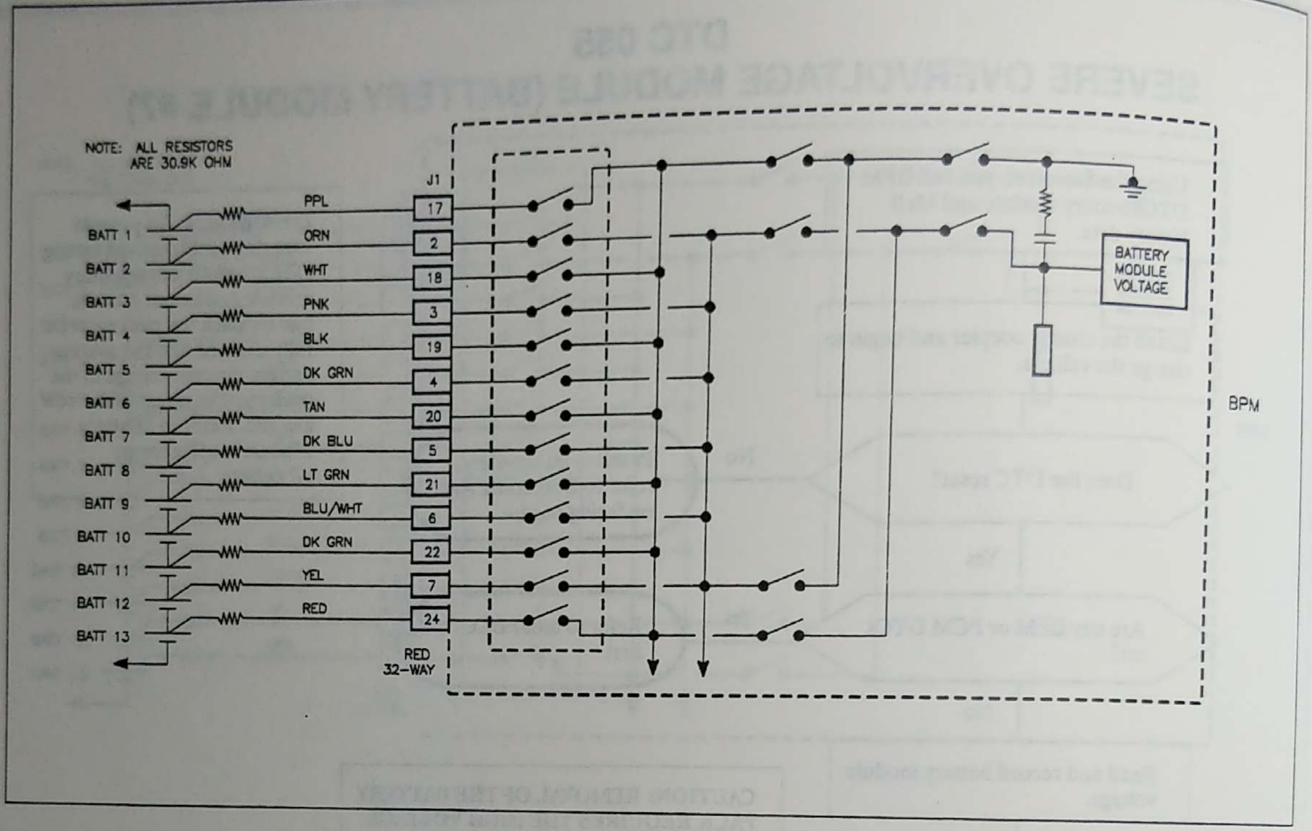
Poor connection at battery module replace cable. After replacement measure module for correct voltage.

Wire between BPM and battery cable sense lead.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 057 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #8)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

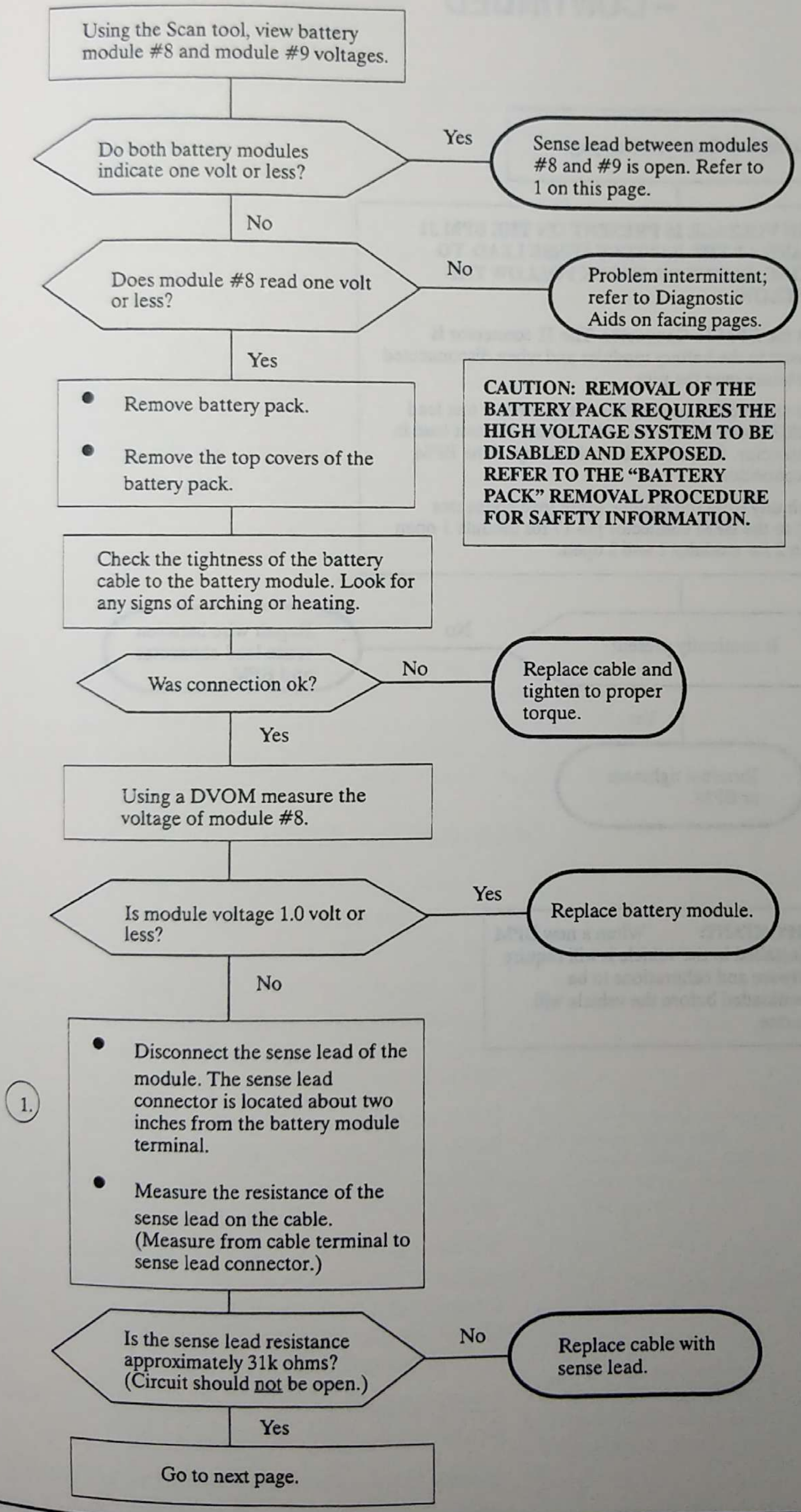
DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:
  1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
  2. Under "HIGH" discharge current (Heavy Load).
  3. When battery module state of charge (SOC) is "LOW."
- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 057
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #8)

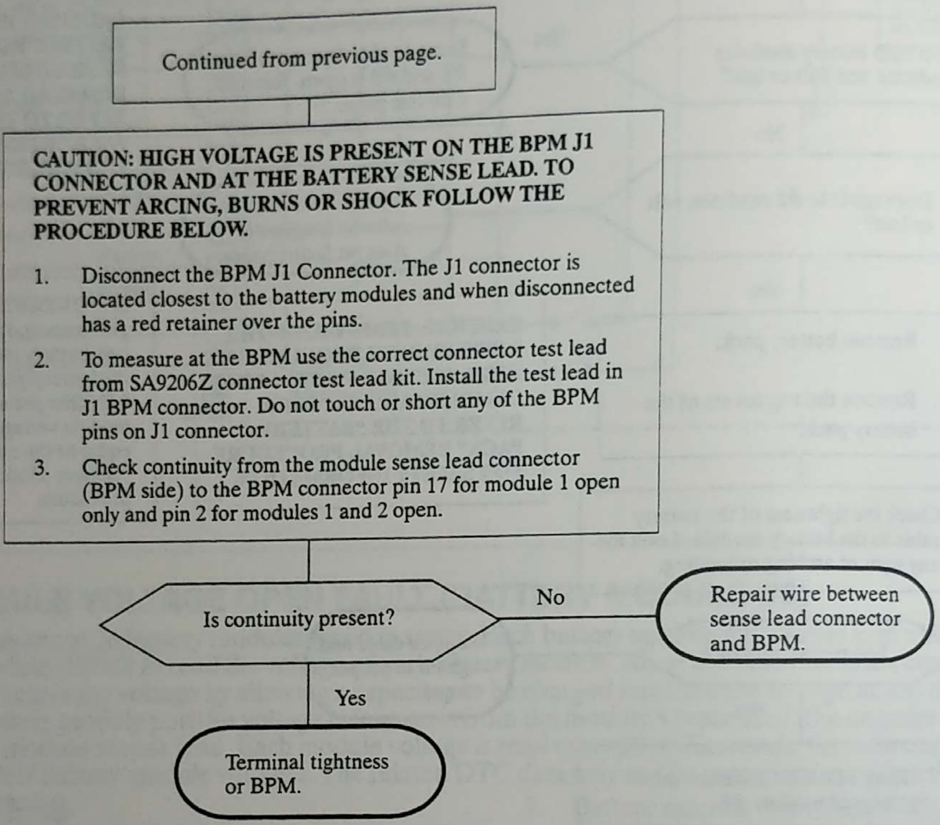

Using the Scan tool, view battery module #8 and module #9 voltages.
Do both battery modules indicate one volt or less?
Yes
Sense lead between modules #8 and #9 is open. Refer to 1 on this page.
No
Does module #8 read one volt or less?
No
Problem intermittent; refer to Diagnostic Aids on facing pages.
Yes
Remove battery pack.
Remove the top covers of the battery pack.
Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.
Was connection ok?
No
Replace cable and tighten to proper torque.
Yes
Using a DVOM measure the voltage of module #8.
Is module voltage 1.0 volt or less?
Yes
Replace battery module.
No
1.
Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)
Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)
No
Replace cable with sense lead.
Yes
Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 057
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #8) – CONTINUED



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CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

Is continuity present?

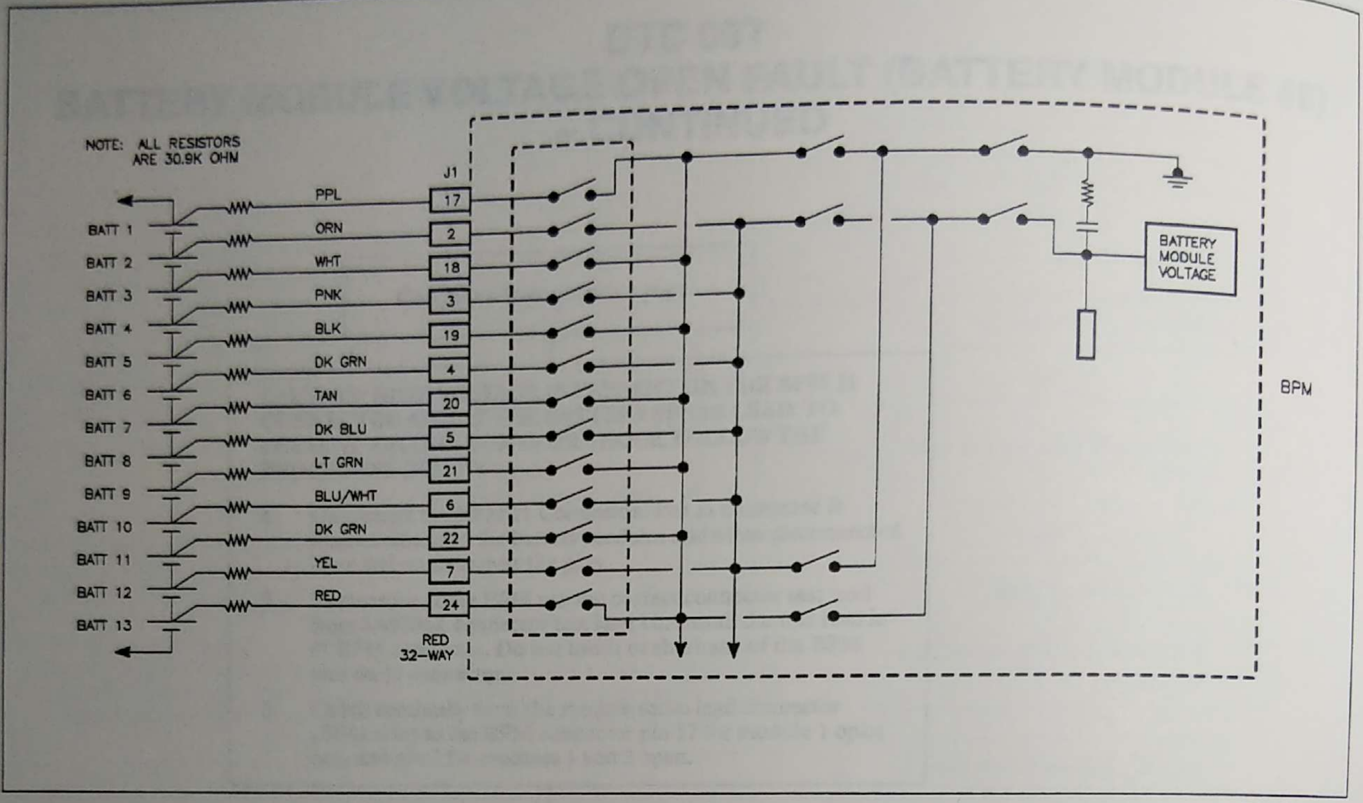
No: Repair wire between sense lead connector and BPM.

Yes: Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 059 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #8)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is 0 to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #8: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

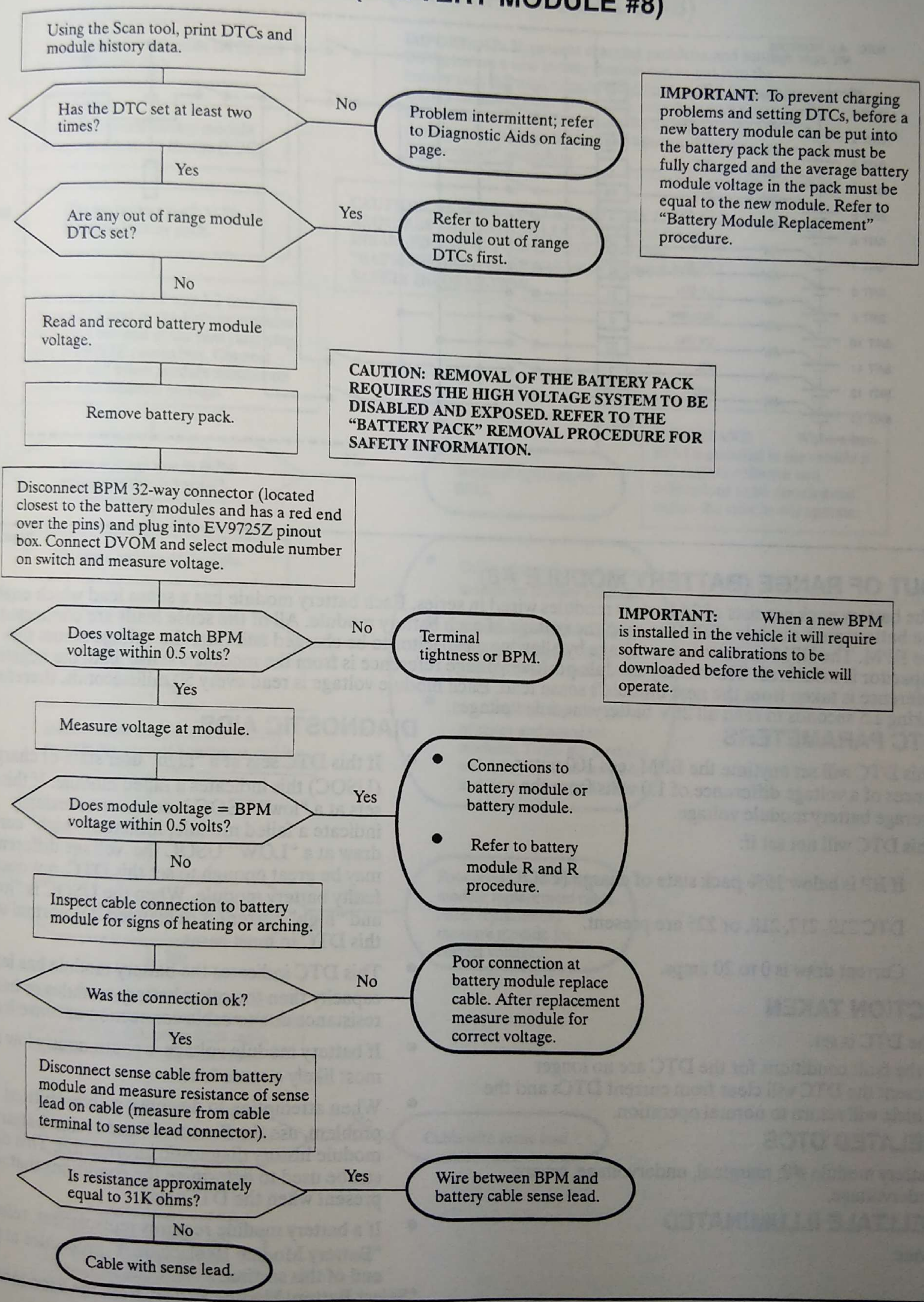
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

DTC 059
MARGINAL (BATTERY MODULE #8)

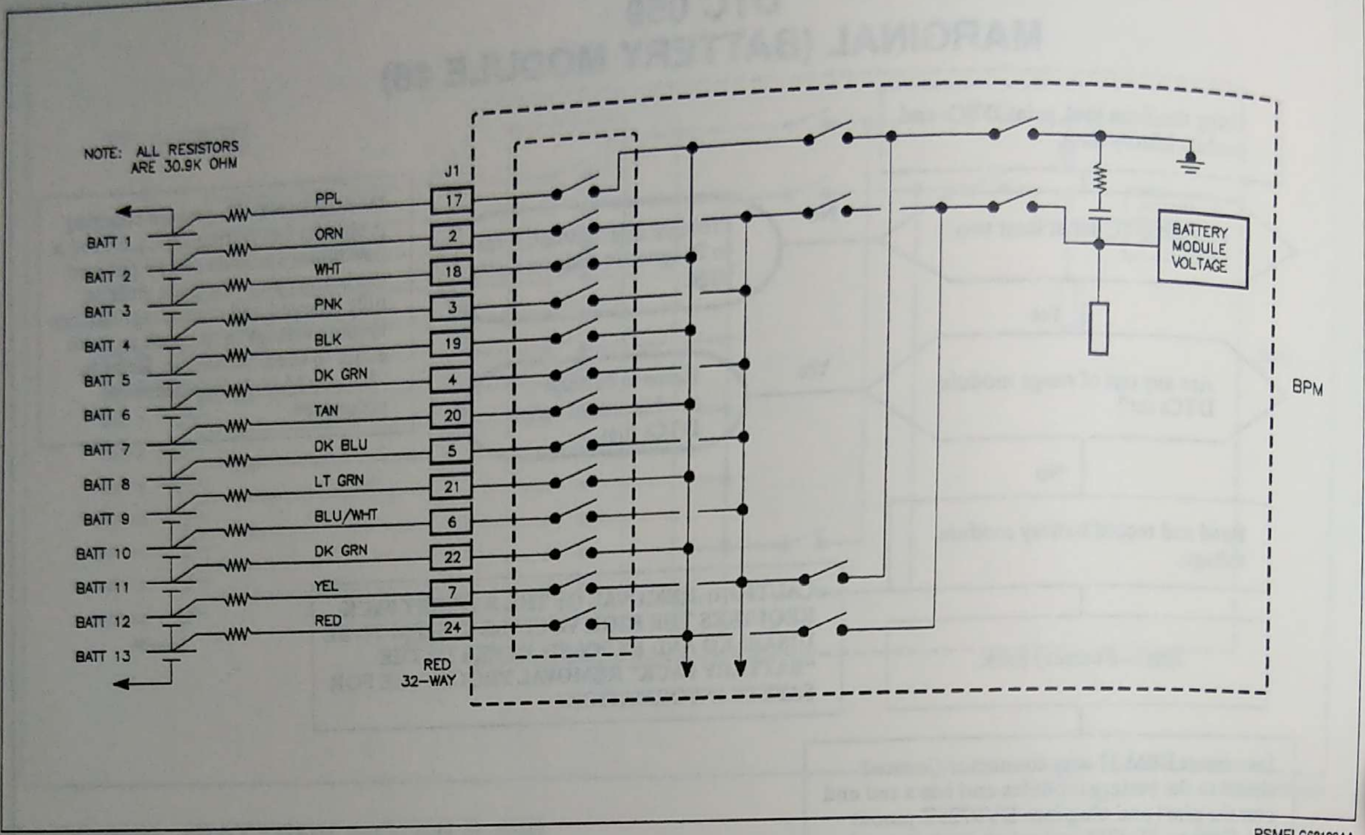

Using the Scan tool, print DTCs and module history data.
Has the DTC set at least two times?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any out of range module DTCs set?
Yes
Refer to battery module out of range DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Connections to battery module or battery module.
• Refer to battery module R and R procedure.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).
Is resistance approximately equal to 31K ohms?
Yes
Wire between BPM and battery cable sense lead.
No
Cable with sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 060 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #8)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is 0 to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #8: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

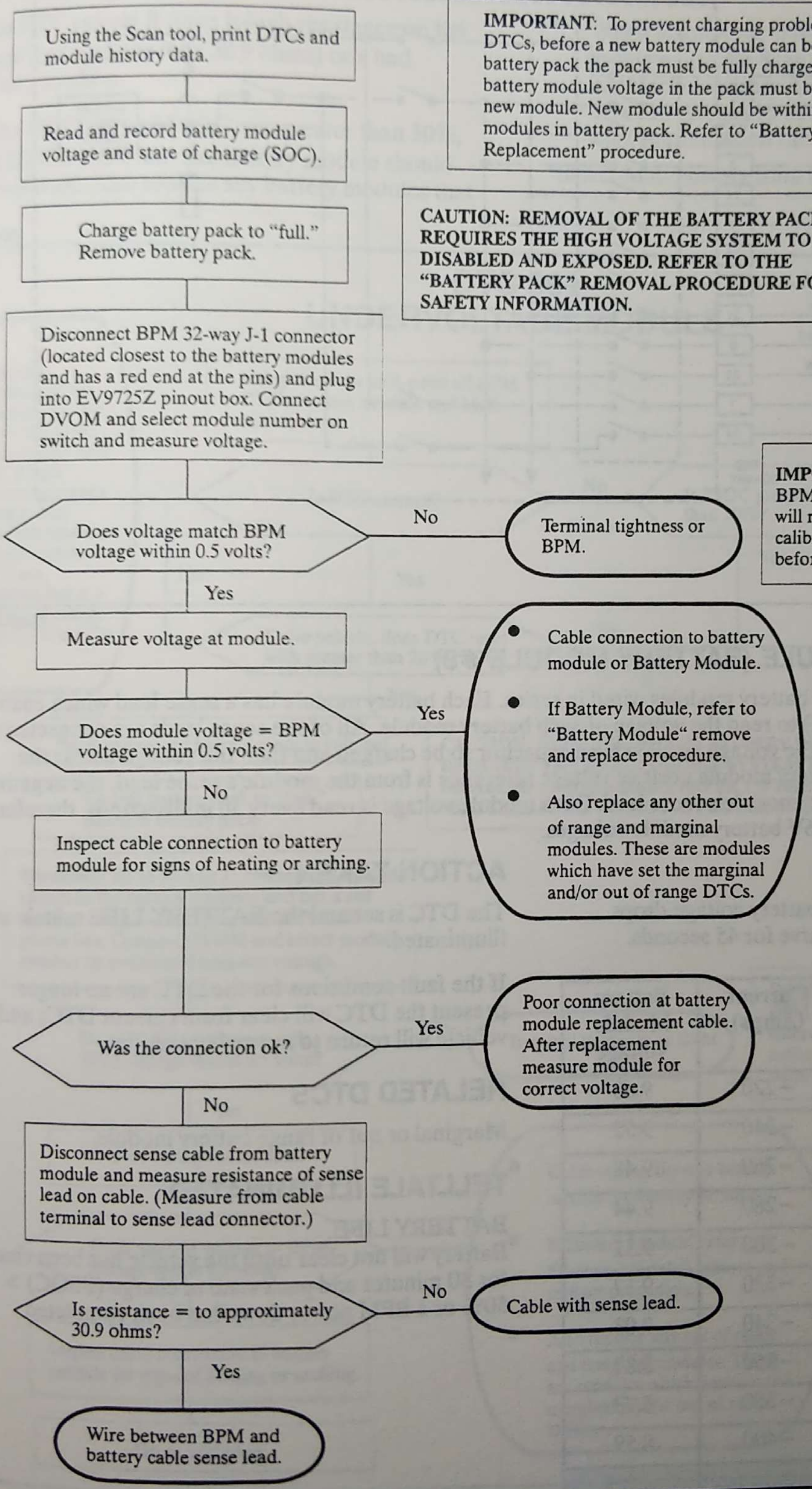
*Select Battery Module History from the Scan tool BPM menu.

DTC 060
OUT OF RANGE (BATTERY MODULE #8)

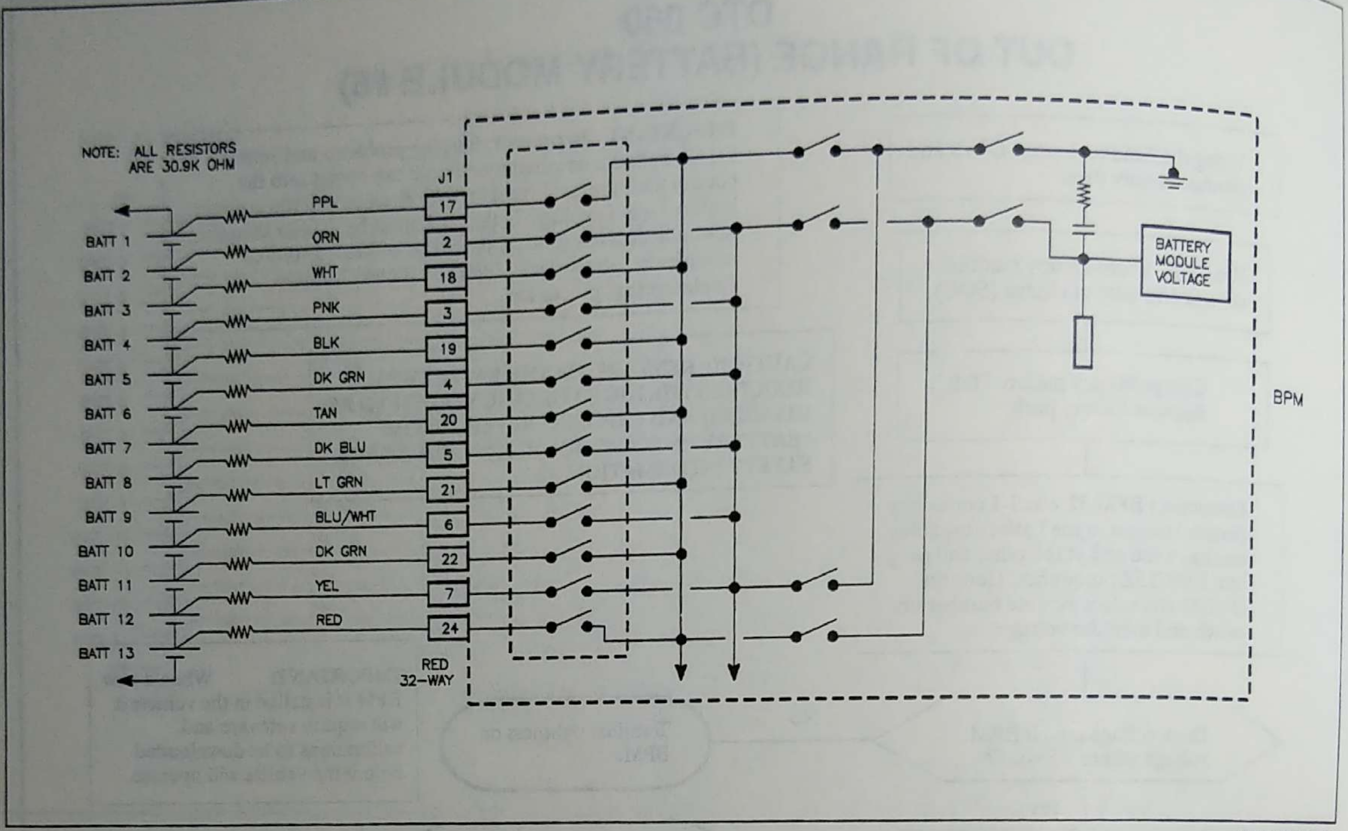
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.


Using the Scan tool, print DTCs and module history data.
Read and record battery module voltage and state of charge (SOC).
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
Cable connection to battery module or Battery Module.
If Battery Module, refer to "Battery Module" remove and replace procedure.
Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
Yes
Poor connection at battery module replacement cable. After replacement measure module for correct voltage.
No
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance = to approximately 30.9 ohms?
No
Cable with sense lead.
Yes
Wire between BPM and battery cable sense lead.

DTC 061 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #8)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage	Current (Amps)	Battery Module Voltage
0	11.75	−220	9.60
−20	11.10	−240	9.52
−40	10.90	−260	9.48
−60	10.65	−280	9.44
−80	10.45	−300	9.31
−100	10.30	−320	9.17
−120	10.15	−340	9.03
−140	10.00	−360	8.87
−160	9.90	−380	8.73
−180	9.80	−400	8.59
−200	9.70		

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

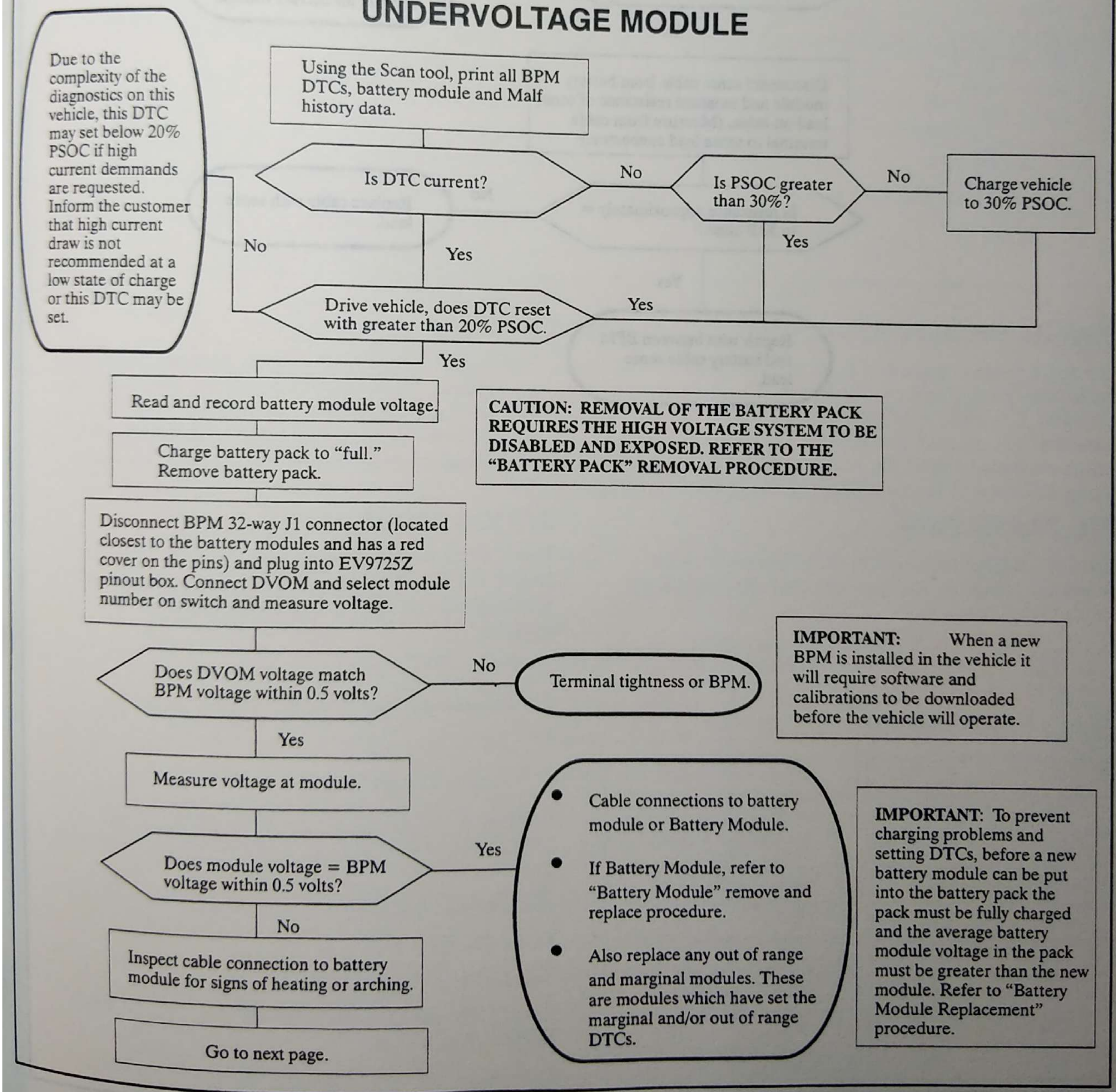
BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

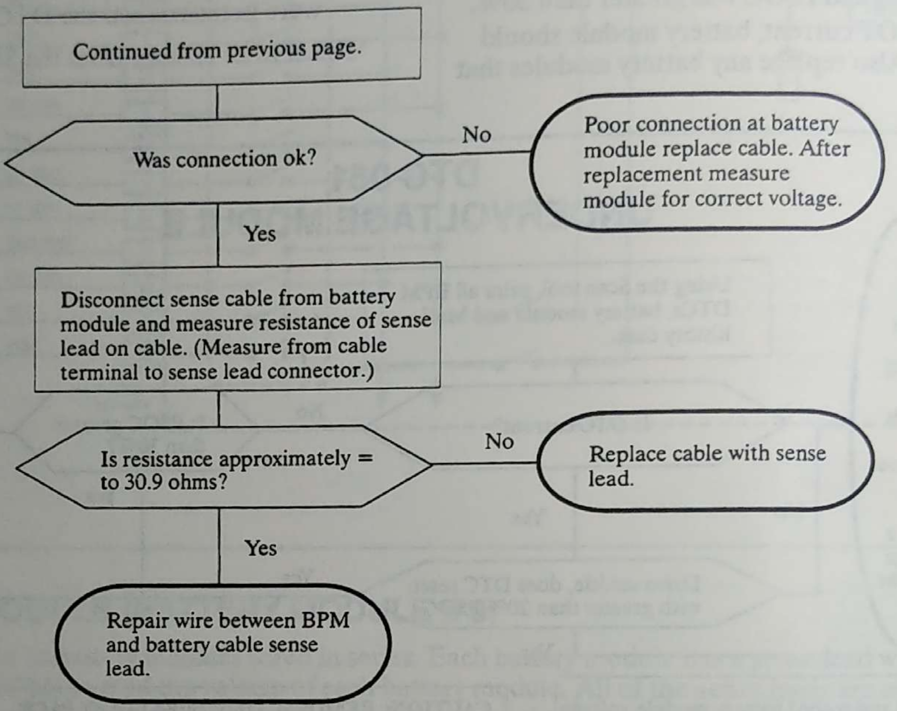
- This DTC can set if vehicle is driven below 0% user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 061
UNDERVOLTAGE MODULE

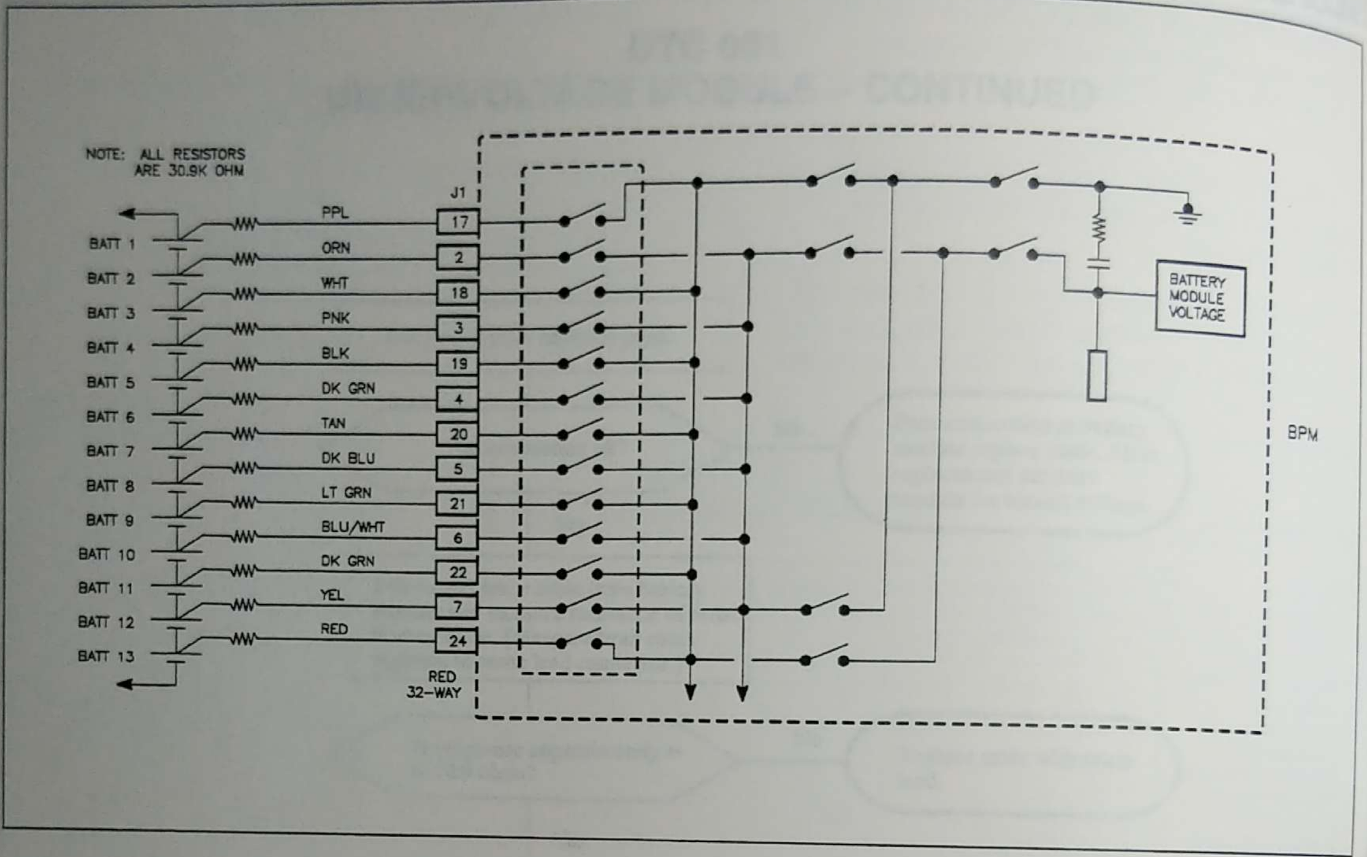

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

DTC 061
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 062 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
J1
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #8)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage
0	11.45
-20	10.55
-40	10.20
-60	9.95
-80	9.75
-100	9.60
-120	9.45
-140	9.30
-160	9.20
-180	9.10
-200	9.00
-220	8.90
-240	8.82
-260	8.78
-280	8.74
-300	8.70
-320	8.66
-340	8.58
-360	8.43
-380	8.28
-400	8.14

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

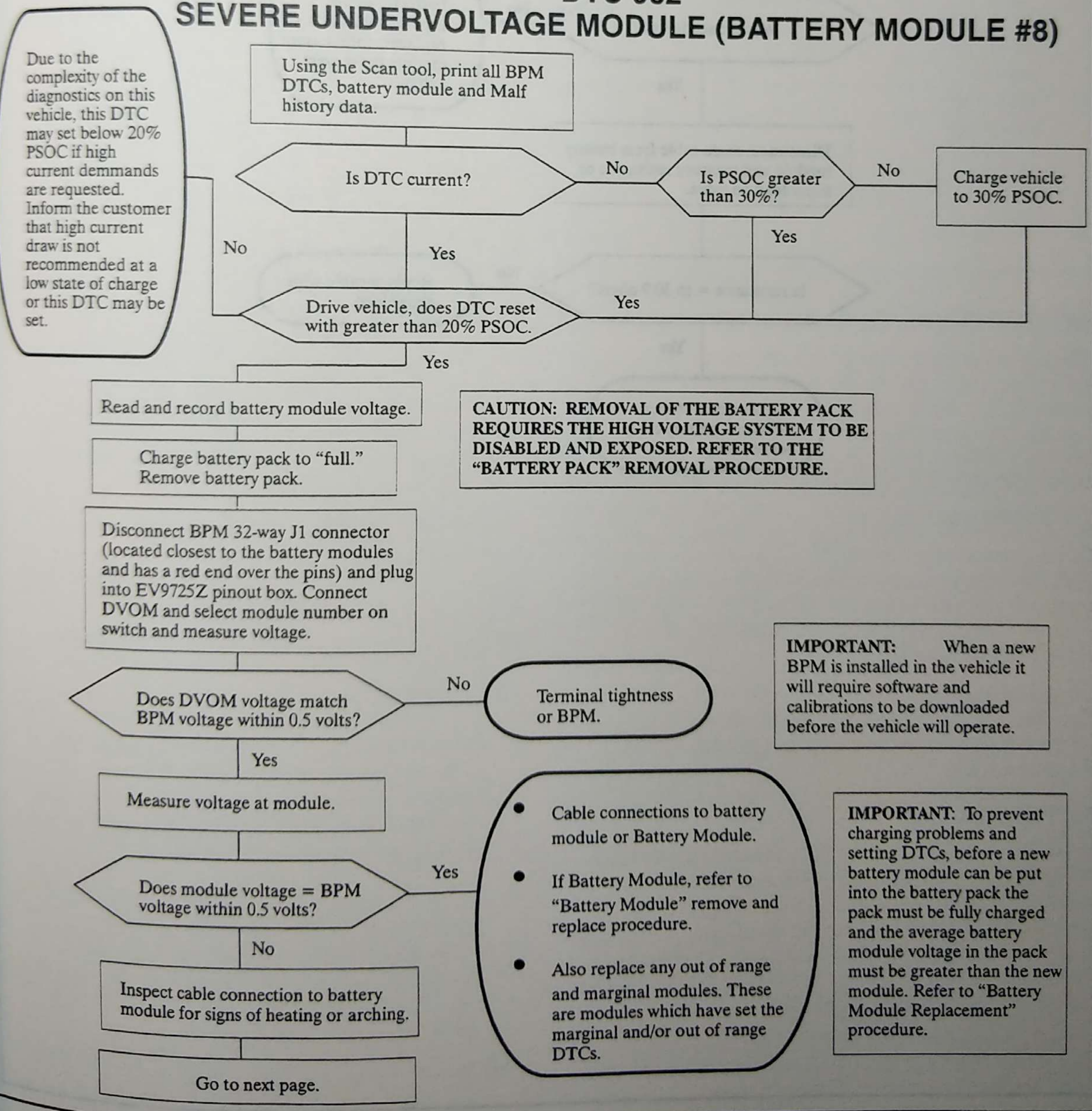
DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches 0% user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 062

DTC 062
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #8)


Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

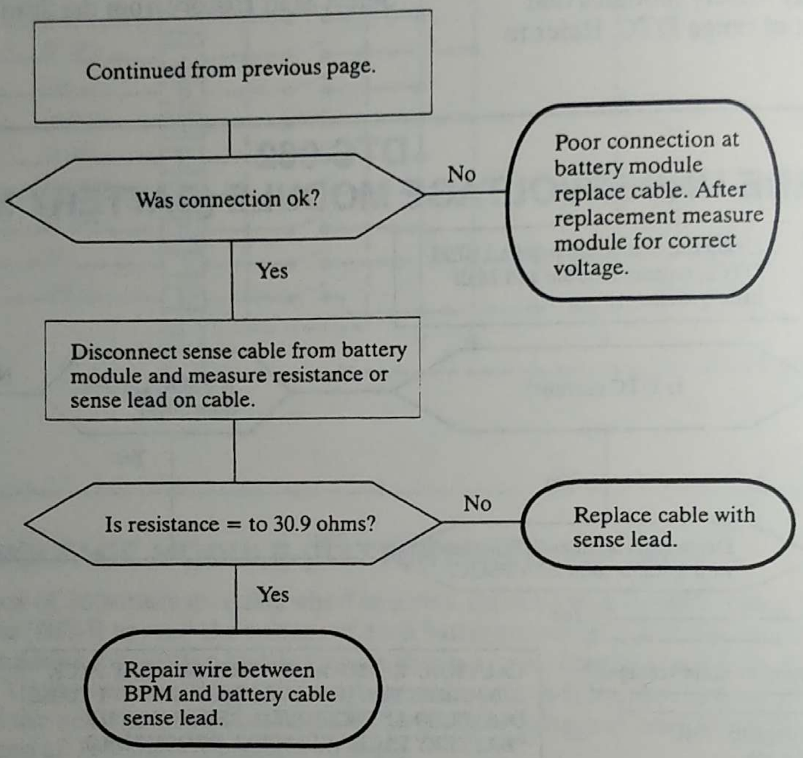
IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

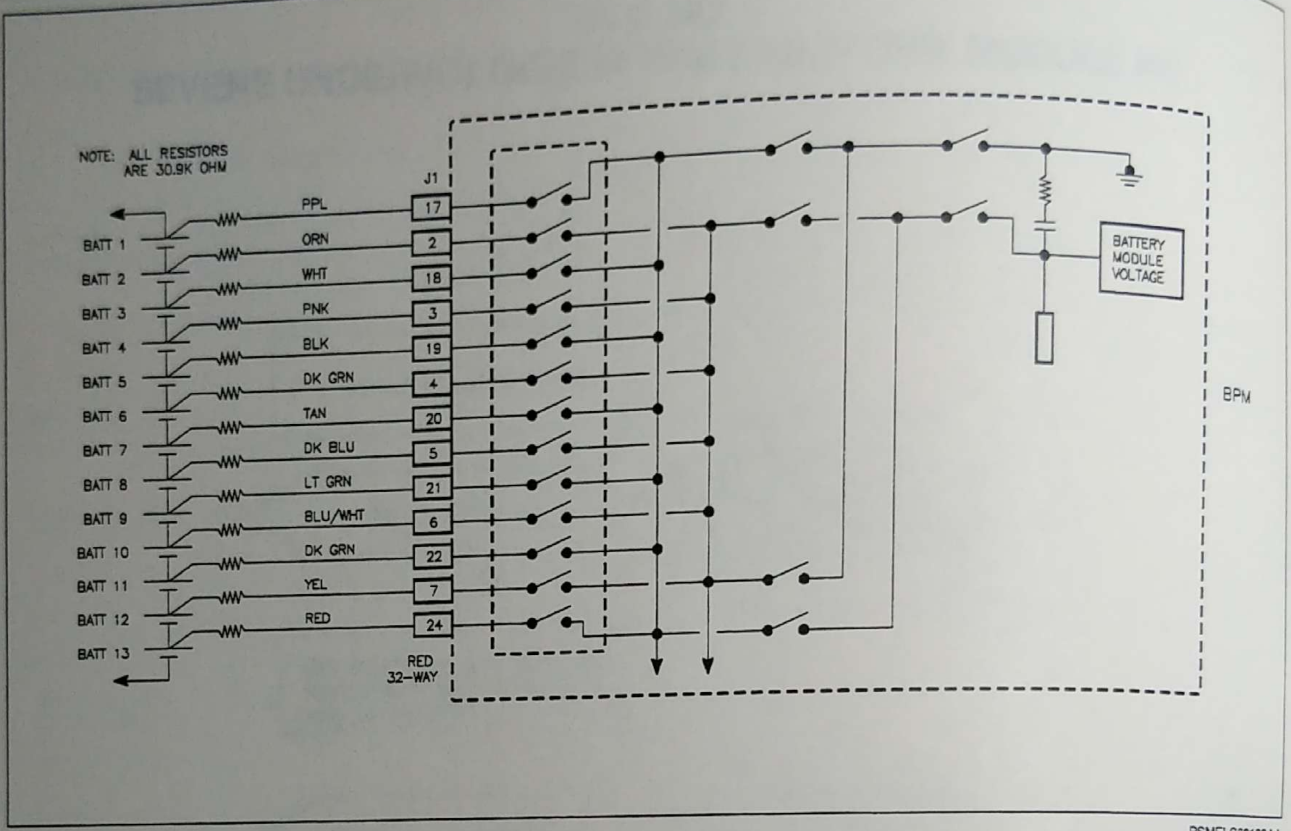
DTC 062

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #8)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 063 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #8)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

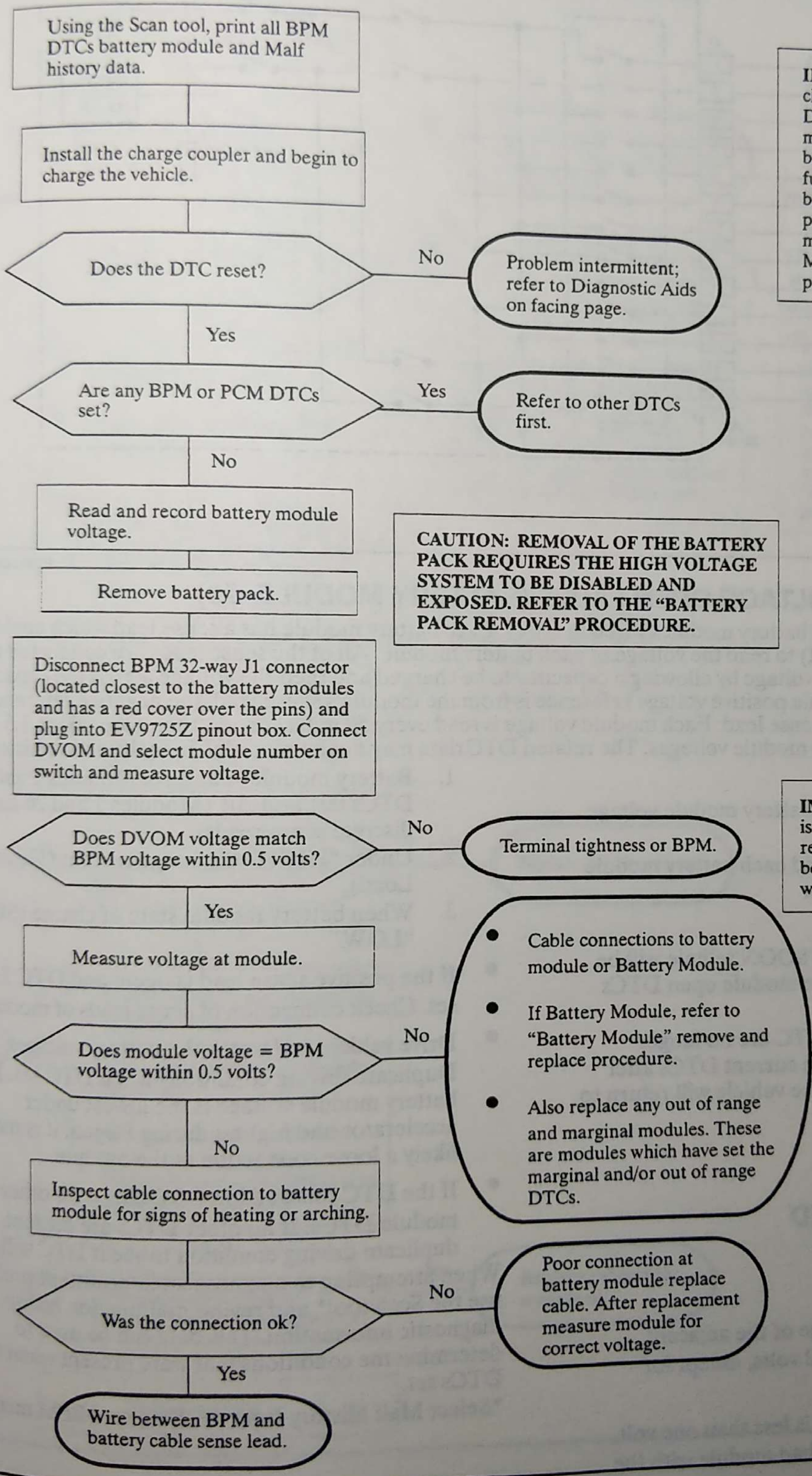
SERVICE NOW and REDUCED PERFORMANCE

DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

DTC 063
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #8)



Using the Scan tool, print all BPM DTCs battery module and Malf history data.

Install the charge coupler and begin to charge the vehicle.

Does the DTC reset?

No: Problem intermittent; refer to Diagnostic Aids on facing page.

Yes: Are any BPM or PCM DTCs set?

Yes: Refer to other DTCs first.

No: Read and record battery module voltage.

Remove battery pack.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

No: Terminal tightness or BPM.

Yes: Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

No:

- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

No: Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

No: Poor connection at battery module replace cable. After replacement measure module for correct voltage.

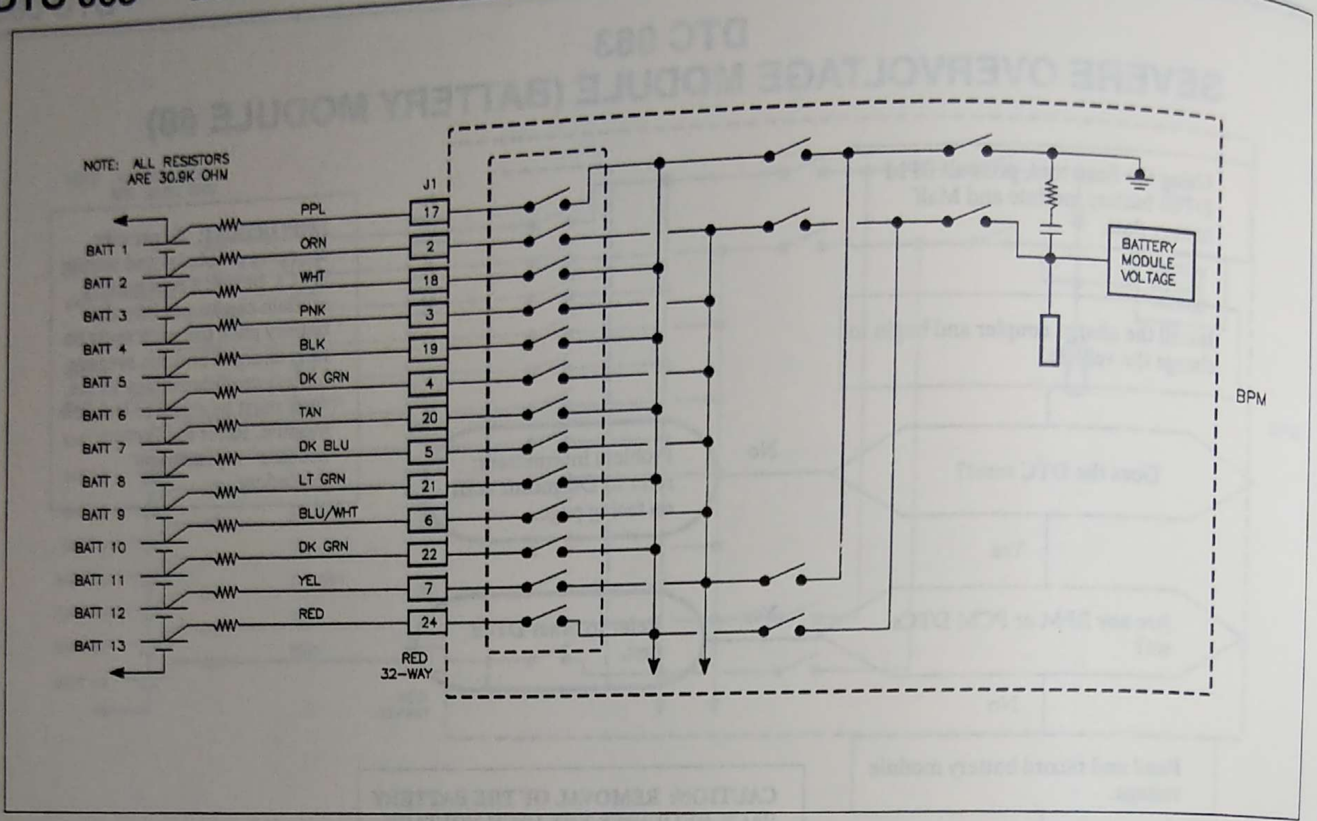
Yes: Wire between BPM and battery cable sense lead.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 065 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #9)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:

1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
2. Under "HIGH" discharge current (Heavy Load).
3. When battery module state of charge (SOC) is "LOW."

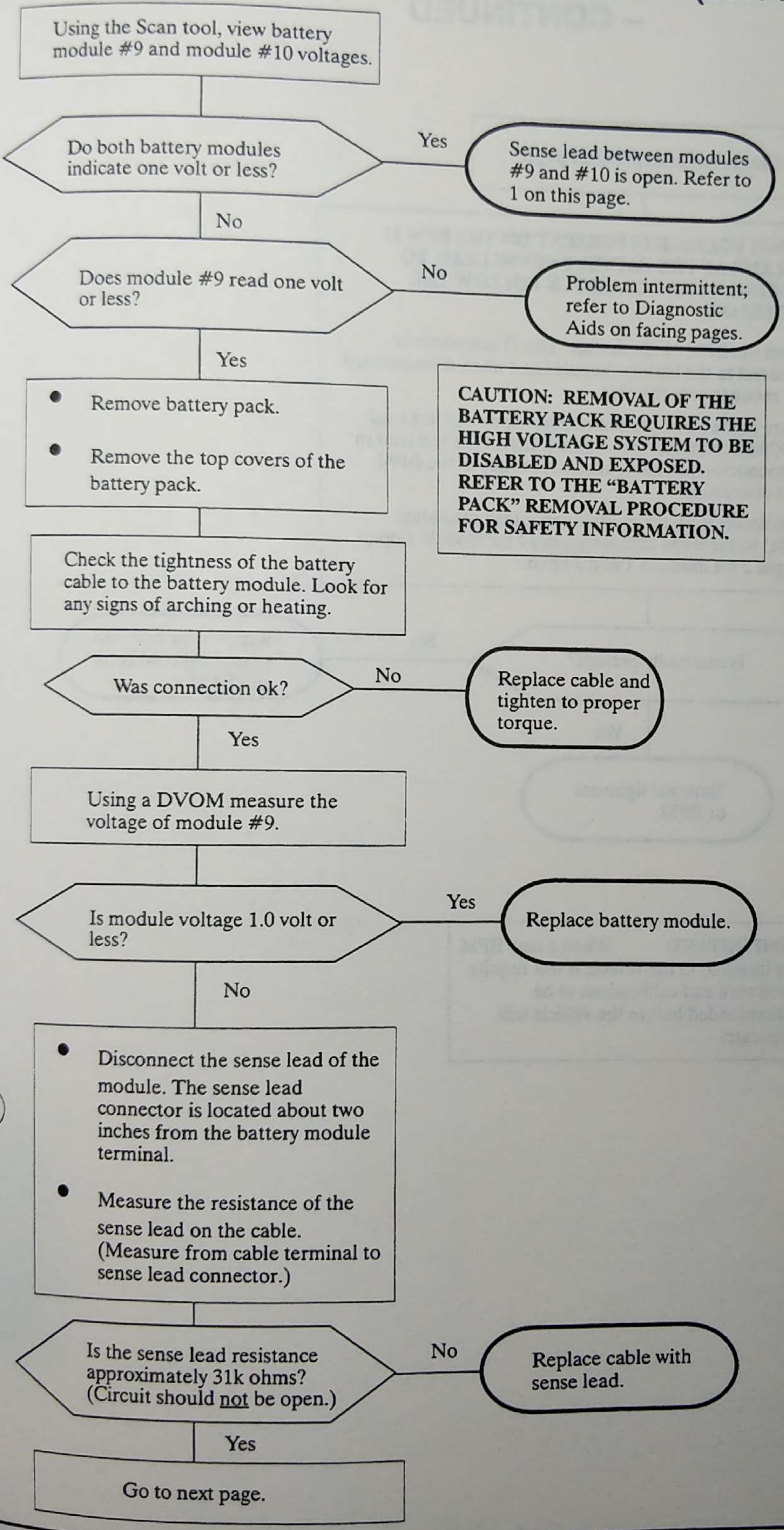
- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 065

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #9)


Using the Scan tool, view battery module #9 and module #10 voltages.
Do both battery modules indicate one volt or less?
Yes
Sense lead between modules #9 and #10 is open. Refer to 1 on this page.
No
Does module #9 read one volt or less?
No
Problem intermittent; refer to Diagnostic Aids on facing pages.
Yes
Remove battery pack.
Remove the top covers of the battery pack.
Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.
Was connection ok?
No
Replace cable and tighten to proper torque.
Yes
Using a DVOM measure the voltage of module #9.
Is module voltage 1.0 volt or less?
Yes
Replace battery module.
No
1.
Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)
Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)
No
Replace cable with sense lead.
Yes
Go to next page.

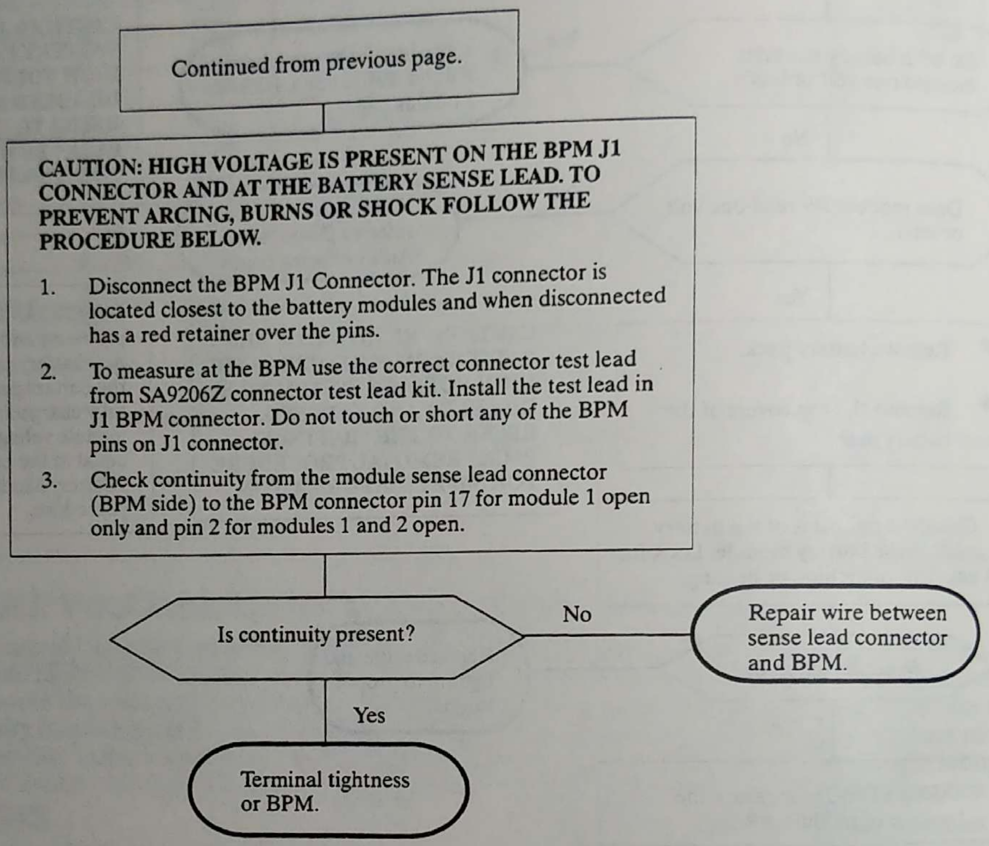
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 065

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #9) – CONTINUED


Continued from previous page.
Is continuity present?
No
Repair wire between sense lead connector and BPM.
Yes
Terminal tightness or BPM.

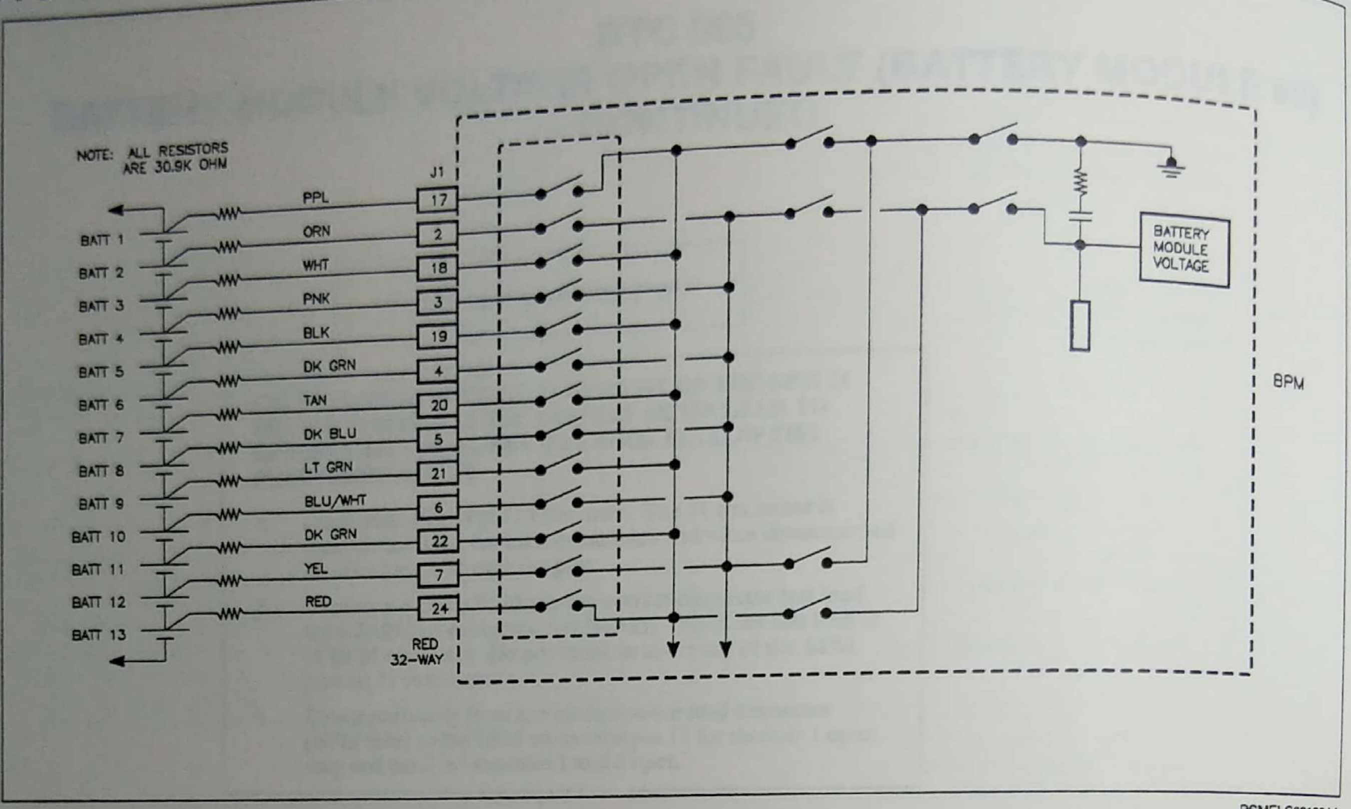
CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 067 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #9)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #9: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

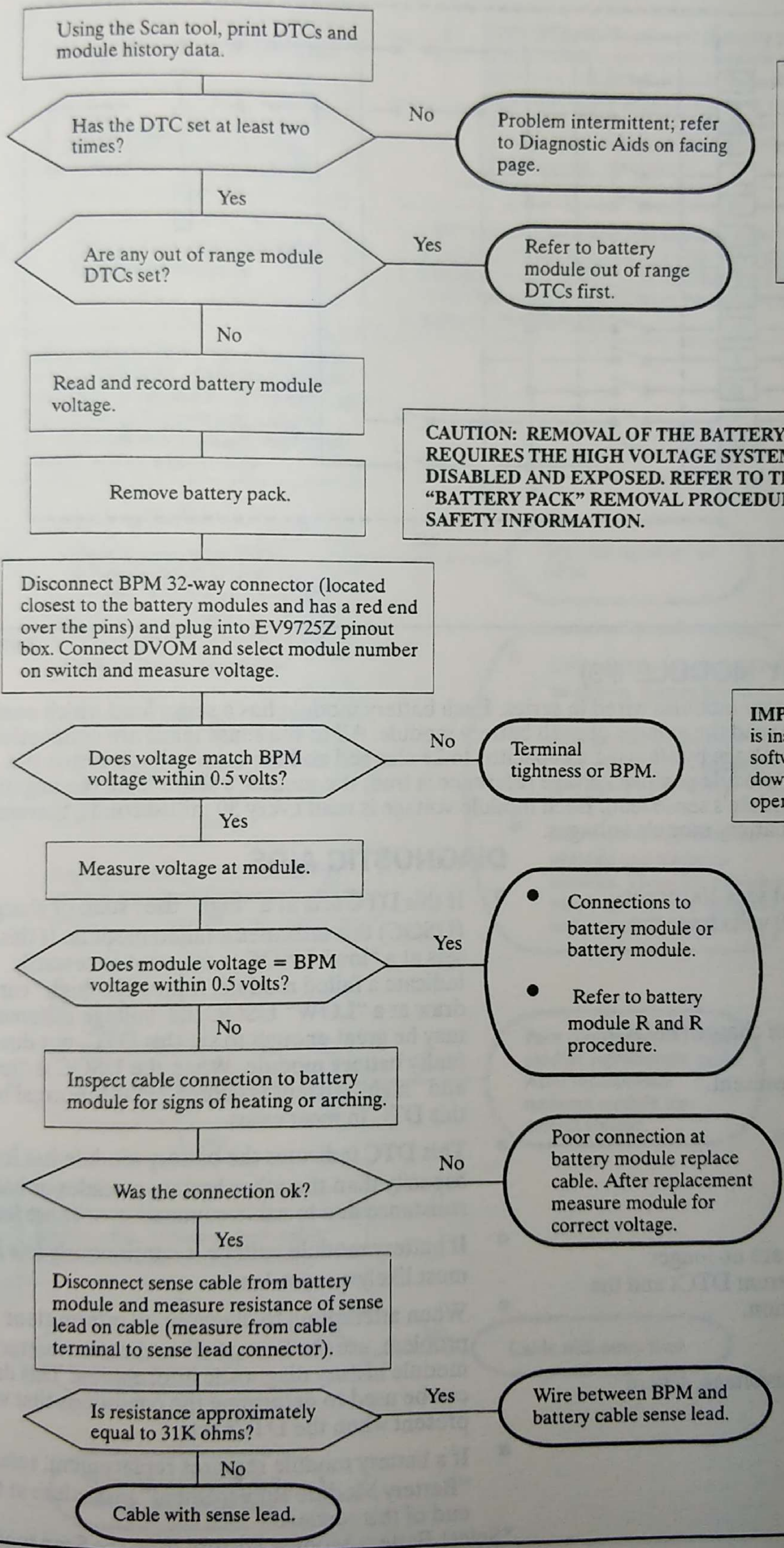
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

DTC 067
MARGINAL (BATTERY MODULE #9)


Using the Scan tool, print DTCs and module history data.
Has the DTC set at least two times?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any out of range module DTCs set?
Yes
Refer to battery module out of range DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Connections to battery module or battery module.
• Refer to battery module R and R procedure.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).
Is resistance approximately equal to 31K ohms?
Yes
Wire between BPM and battery cable sense lead.
No
Cable with sense lead.

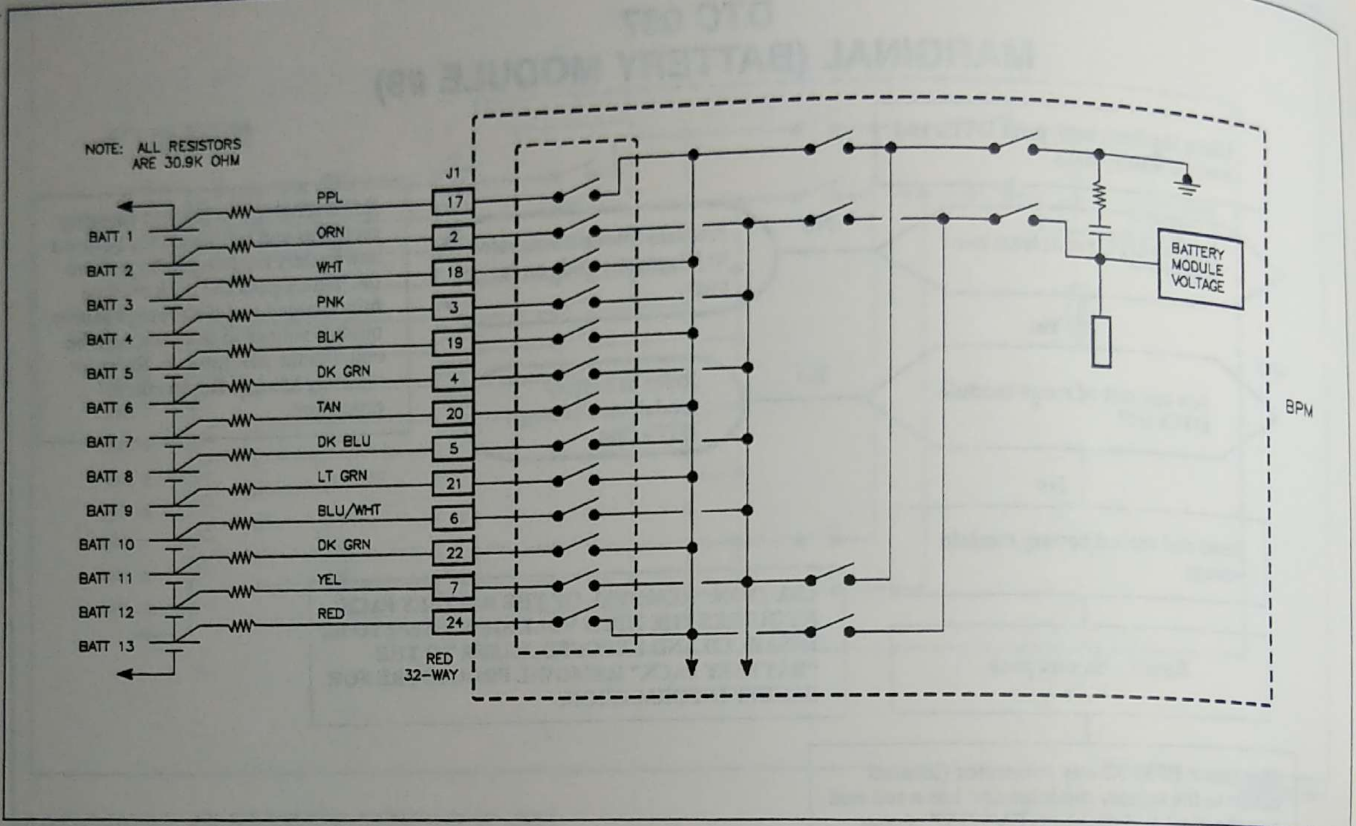
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

CS CamScanner

DTC 068 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #9)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #9: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

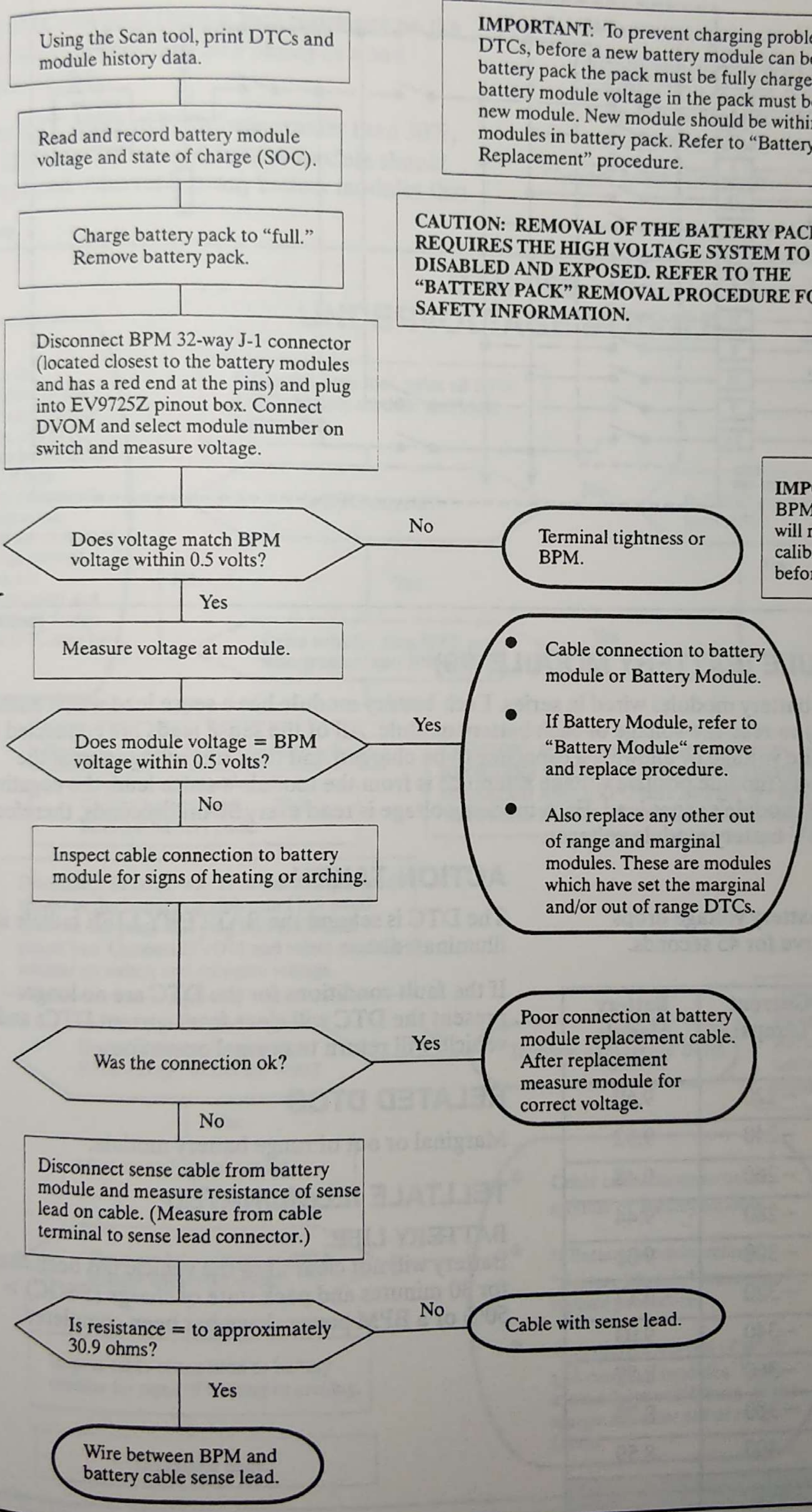
- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

*Select Battery Module History from the Scan tool BPM menu.

DTC 068
OUT OF RANGE (BATTERY MODULE #9)

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.



Using the Scan tool, print DTCs and module history data.

Read and record battery module voltage and state of charge (SOC).

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

No: Terminal tightness or BPM.

Yes: Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

Yes:

- Cable connection to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

No: Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Yes: Poor connection at battery module replacement cable. After replacement measure module for correct voltage.

No: Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)

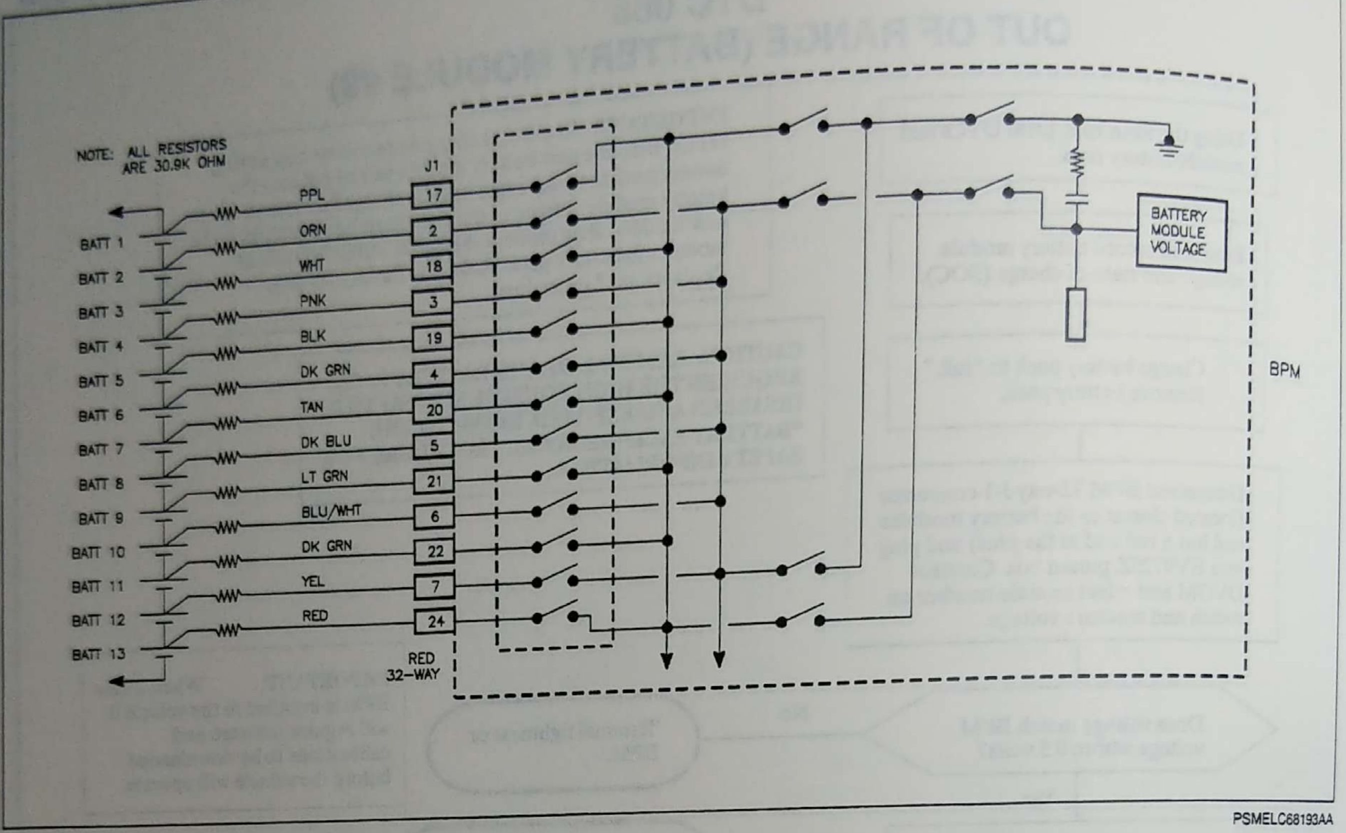
Is resistance = to approximately 30.9 ohms?

No: Cable with sense lead.

Yes: Wire between BPM and battery cable sense lead.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 069 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
J1
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM
PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #9)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage	Current (Amps)	Battery Module Voltage
0	11.75	−220	9.60
−20	11.10	−240	9.52
−40	10.90	−260	9.48
−60	10.65	−280	9.44
−80	10.45	−300	9.31
−100	10.30	−320	9.17
−120	10.15	−340	9.03
−140	10.00	−360	8.87
−160	9.90	−380	8.73
−180	9.80	−400	8.59
−200	9.70		

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

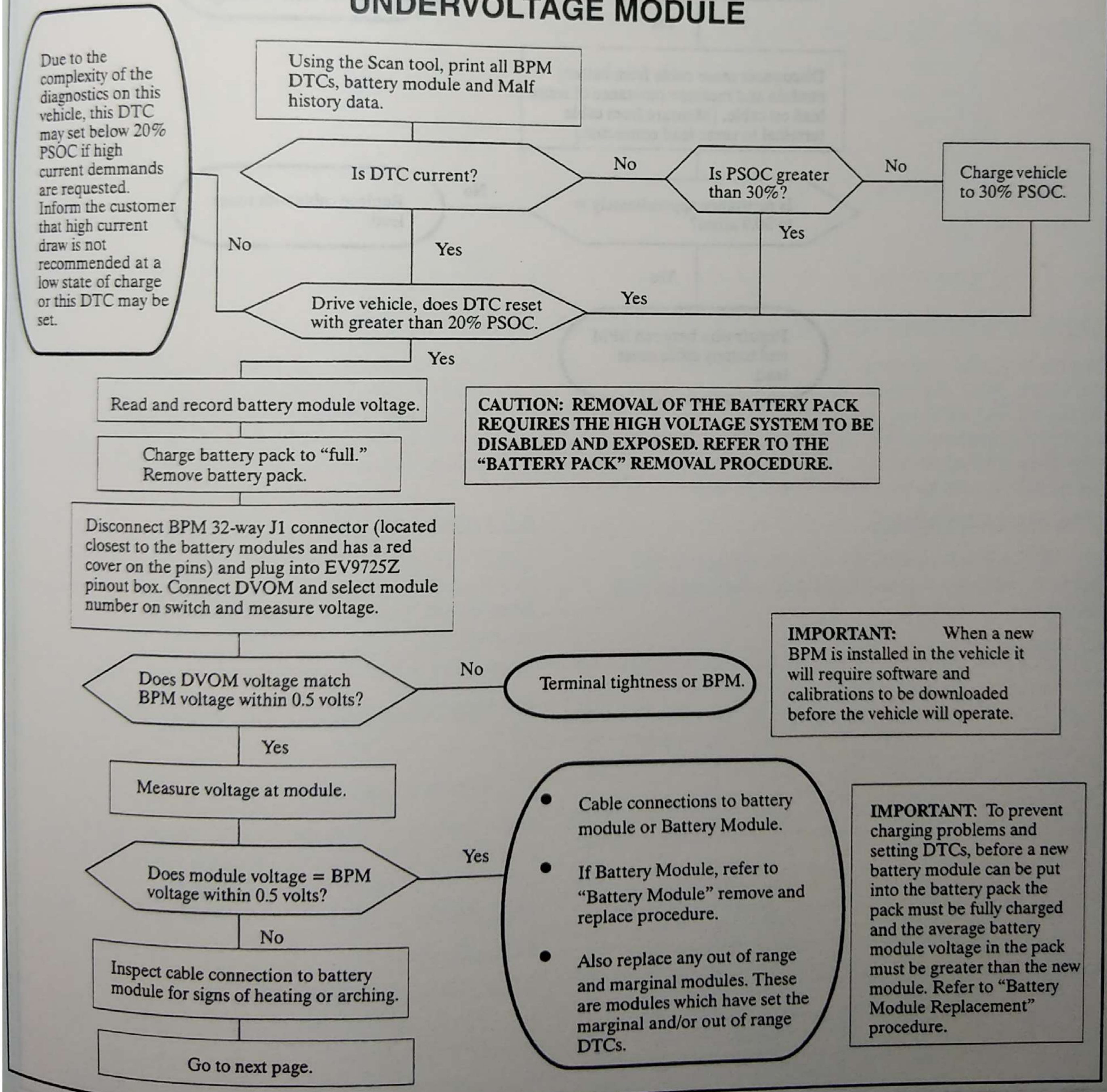
BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below zero percent user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 069
UNDERVOLTAGE MODULE



Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

Using the Scan tool, print all BPM DTCs, battery module and Malf history data.

Is DTC current?

Is PSOC greater than 30%?

Charge vehicle to 30% PSOC.

Drive vehicle, does DTC reset with greater than 20% PSOC.

Read and record battery module voltage.

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

Inspect cable connection to battery module for signs of heating or arching.

Go to next page.

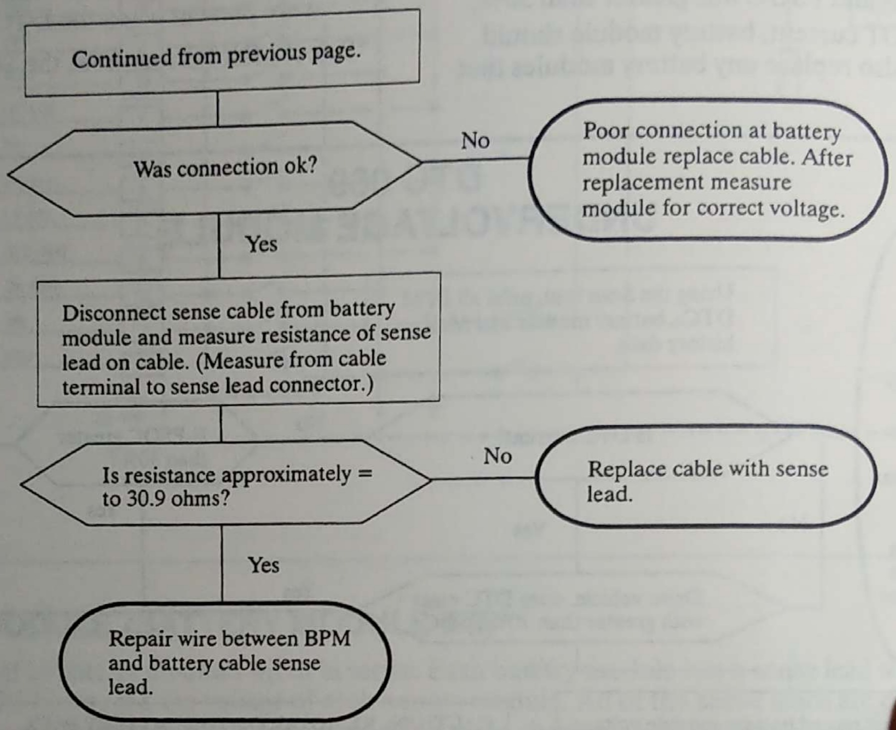
- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

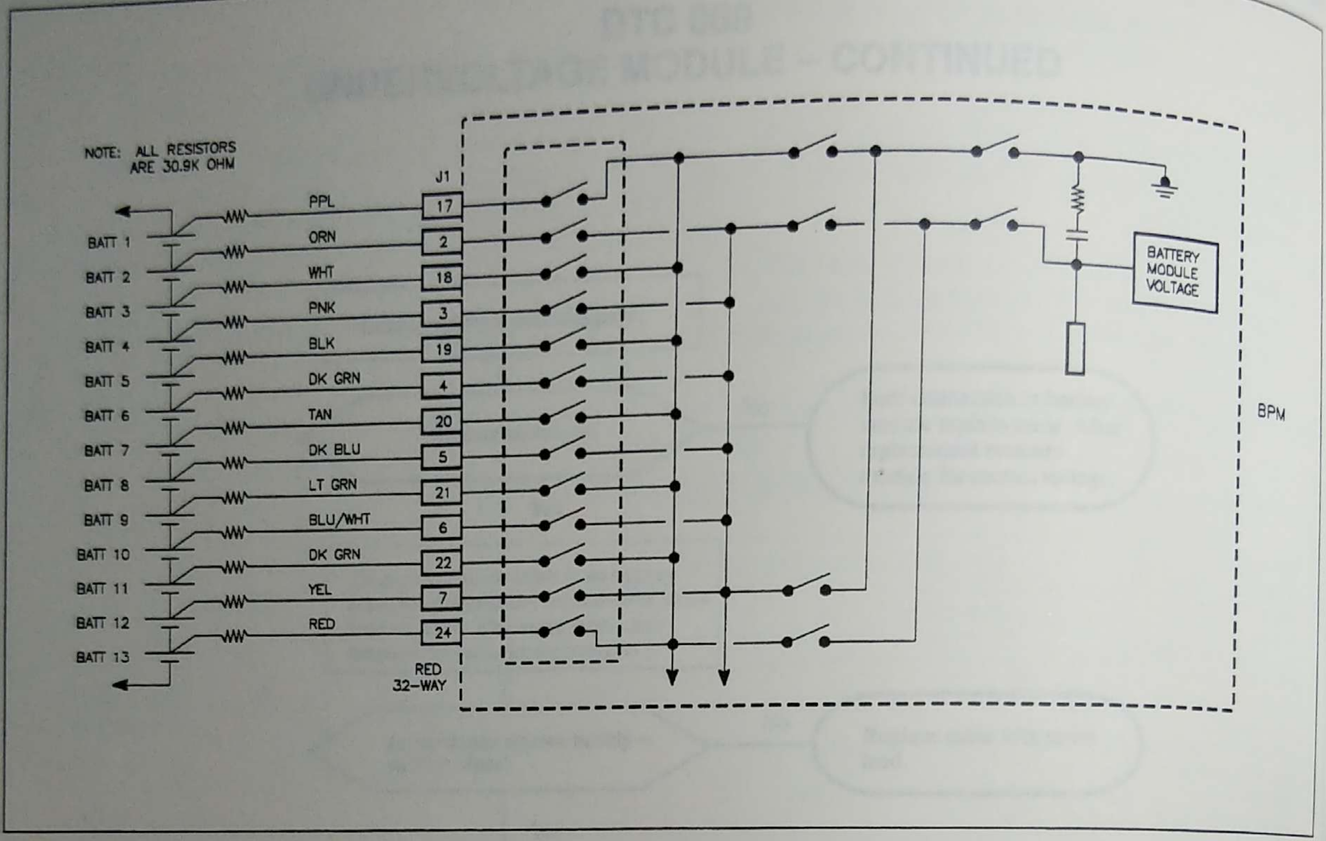
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 069
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 070 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #9)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

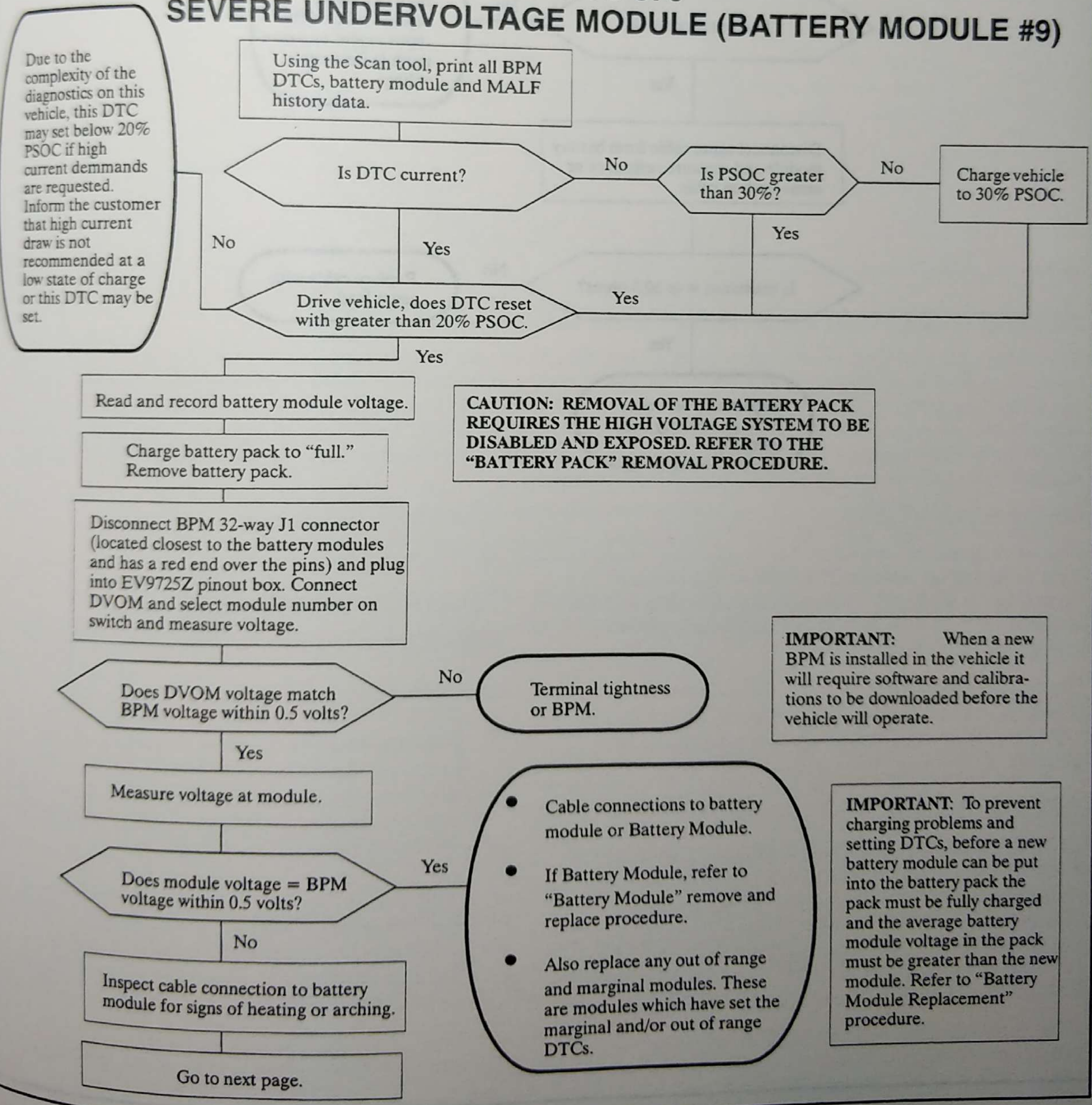
DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches zero percent user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 070

DTC 070
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #9)


Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

Using the Scan tool, print all BPM DTCs, battery module and MALF history data.

Is DTC current?

Is PSOC greater than 30%?

Charge vehicle to 30% PSOC.

Drive vehicle, does DTC reset with greater than 20% PSOC.

Read and record battery module voltage.

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

Inspect cable connection to battery module for signs of heating or arching.

Go to next page.

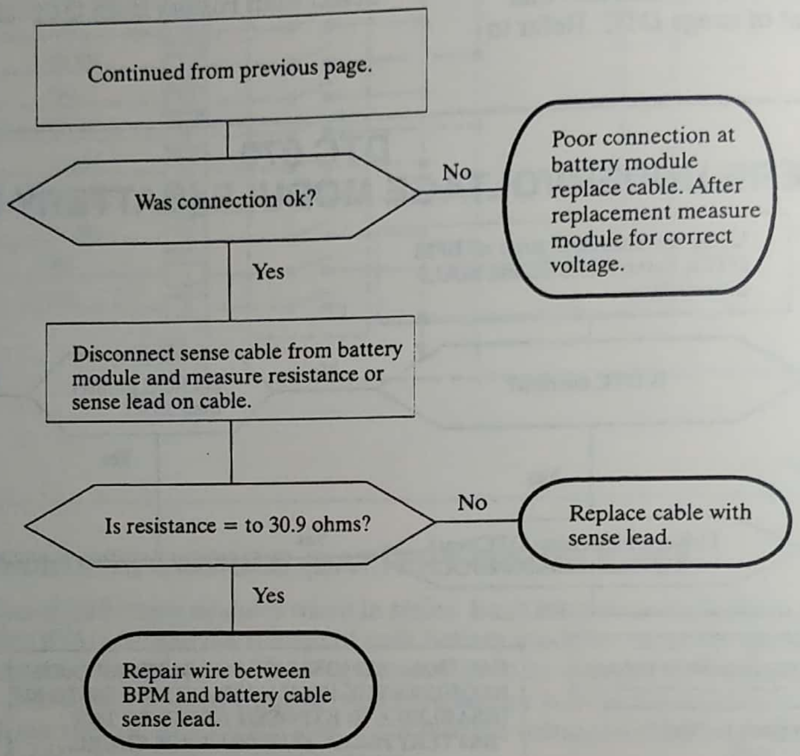
- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

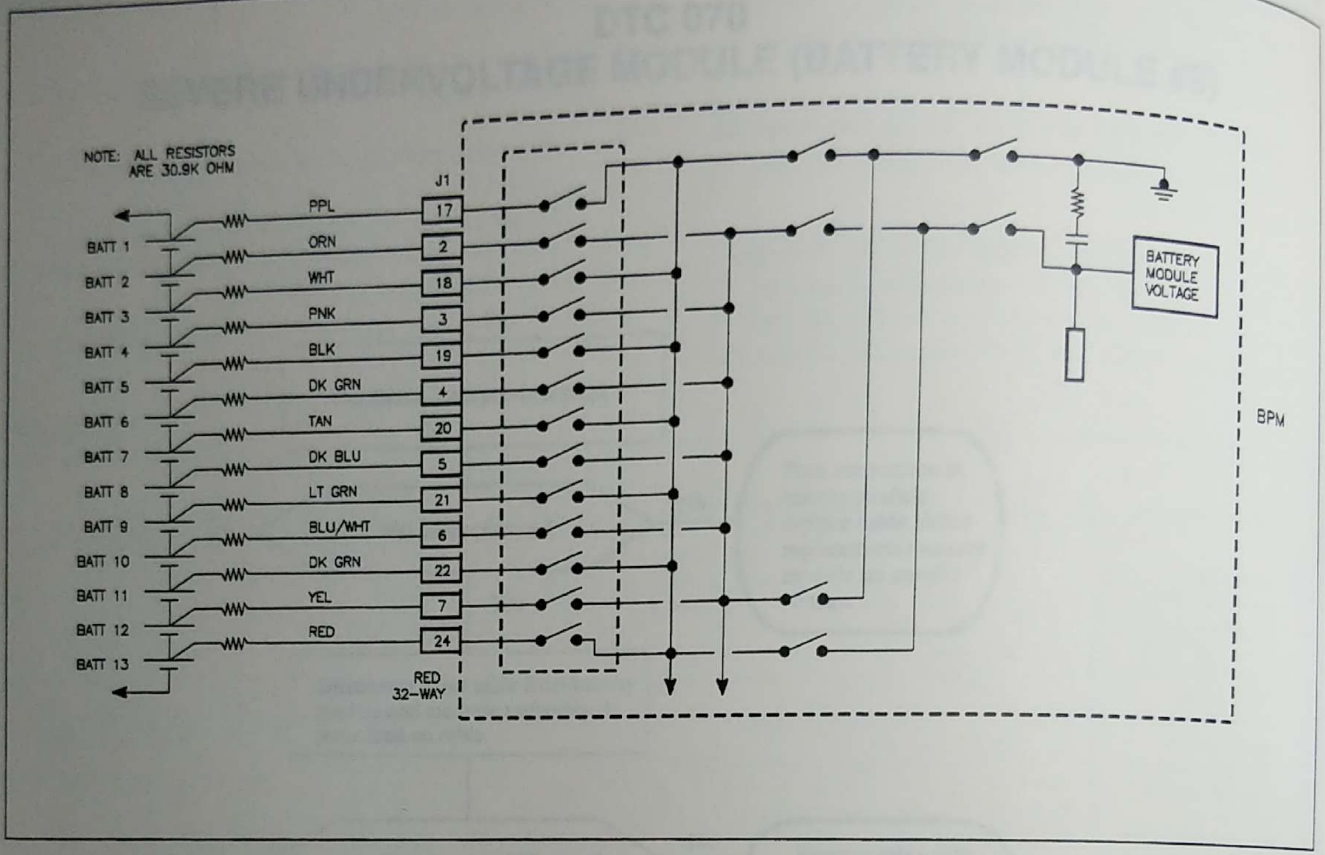
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 070
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #9)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 071 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #9)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

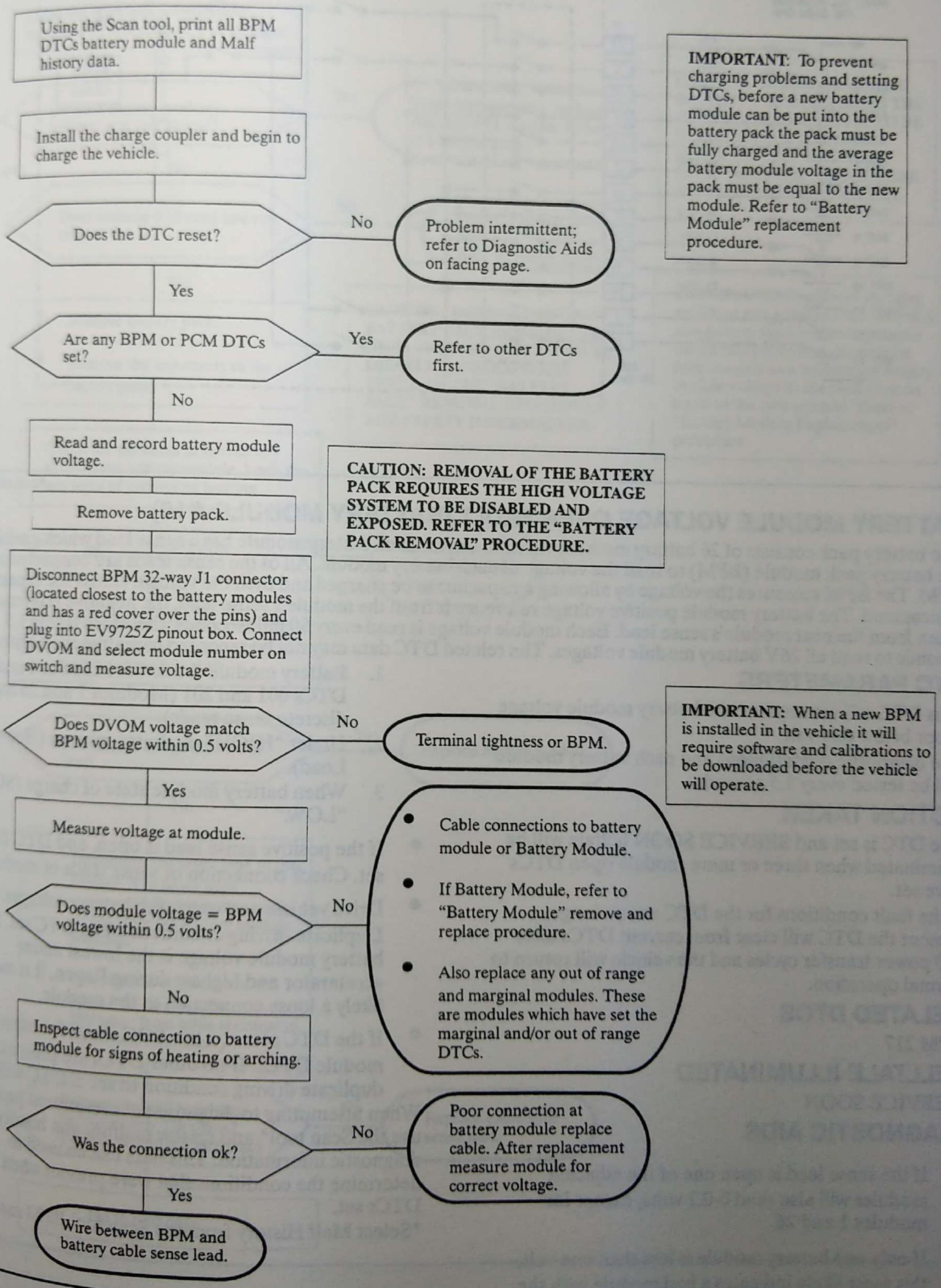
SERVICE NOW and REDUCED PERFORMANCE

DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

DTC 071
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #9)

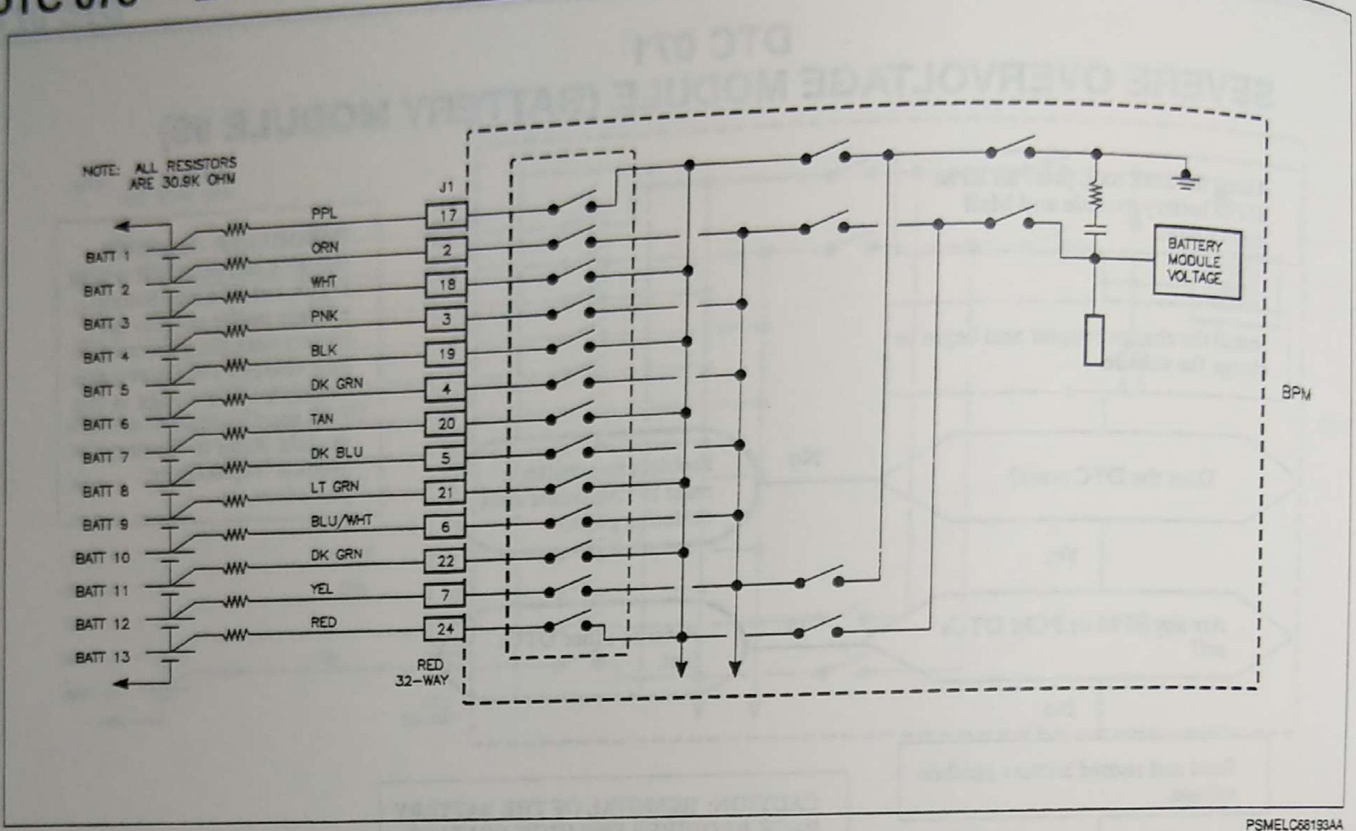

Using the Scan tool, print all BPM DTCs battery module and Malf history data.
Install the charge coupler and begin to charge the vehicle.
Does the DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any BPM or PCM DTCs set?
Yes
Refer to other DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
No
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 073 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #10)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

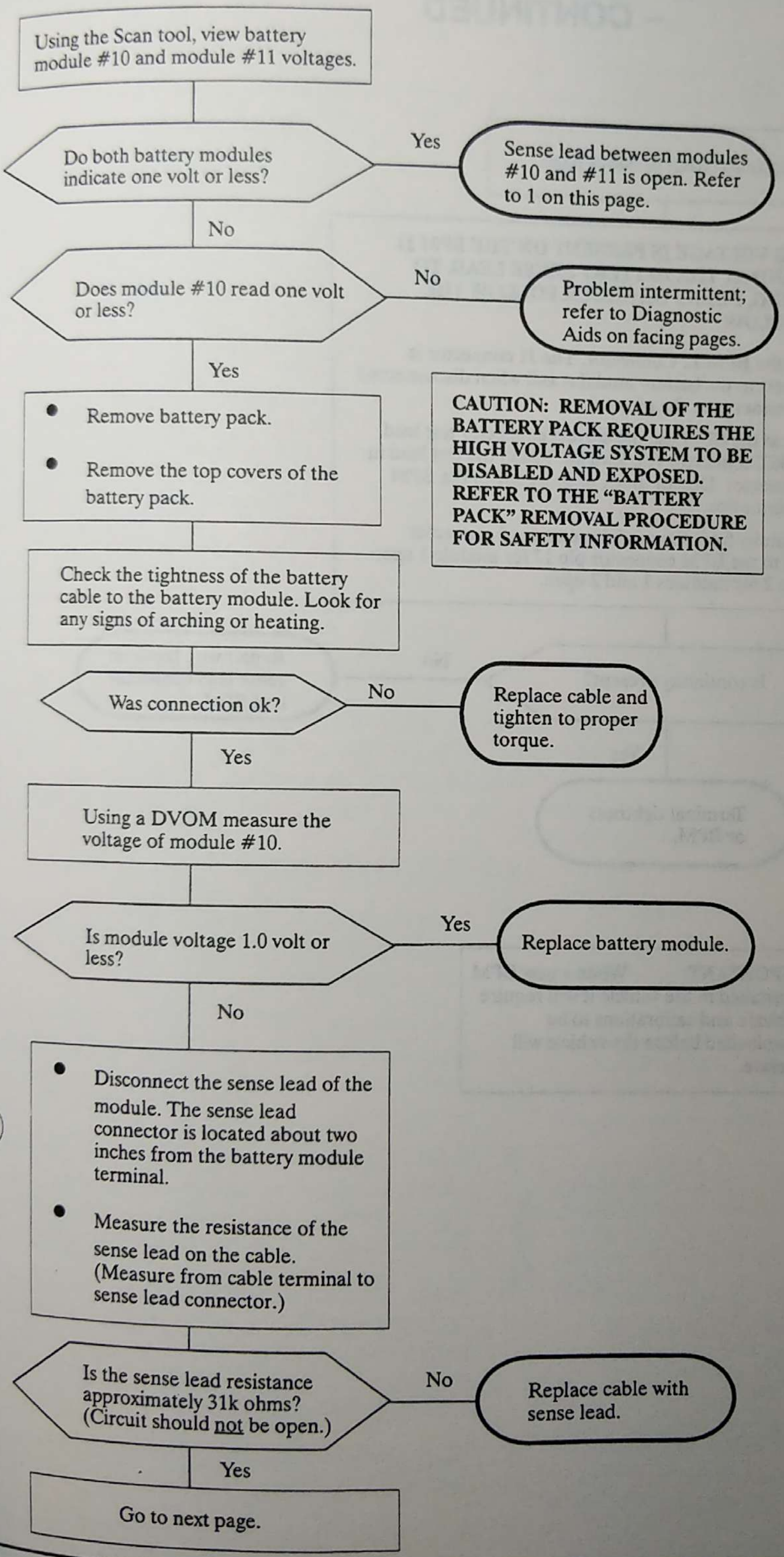
DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:
  1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
  2. Under "HIGH" discharge current (Heavy Load).
  3. When battery module state of charge (SOC) is "LOW."
- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 073
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #10)


Using the Scan tool, view battery module #10 and module #11 voltages.
Do both battery modules indicate one volt or less?
Yes
Sense lead between modules #10 and #11 is open. Refer to 1 on this page.
No
Does module #10 read one volt or less?
No
Problem intermittent; refer to Diagnostic Aids on facing pages.
Yes
Remove battery pack.
Remove the top covers of the battery pack.
Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.
Was connection ok?
No
Replace cable and tighten to proper torque.
Yes
Using a DVOM measure the voltage of module #10.
Is module voltage 1.0 volt or less?
Yes
Replace battery module.
No
1.
Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)
Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)
No
Replace cable with sense lead.
Yes
Go to next page.

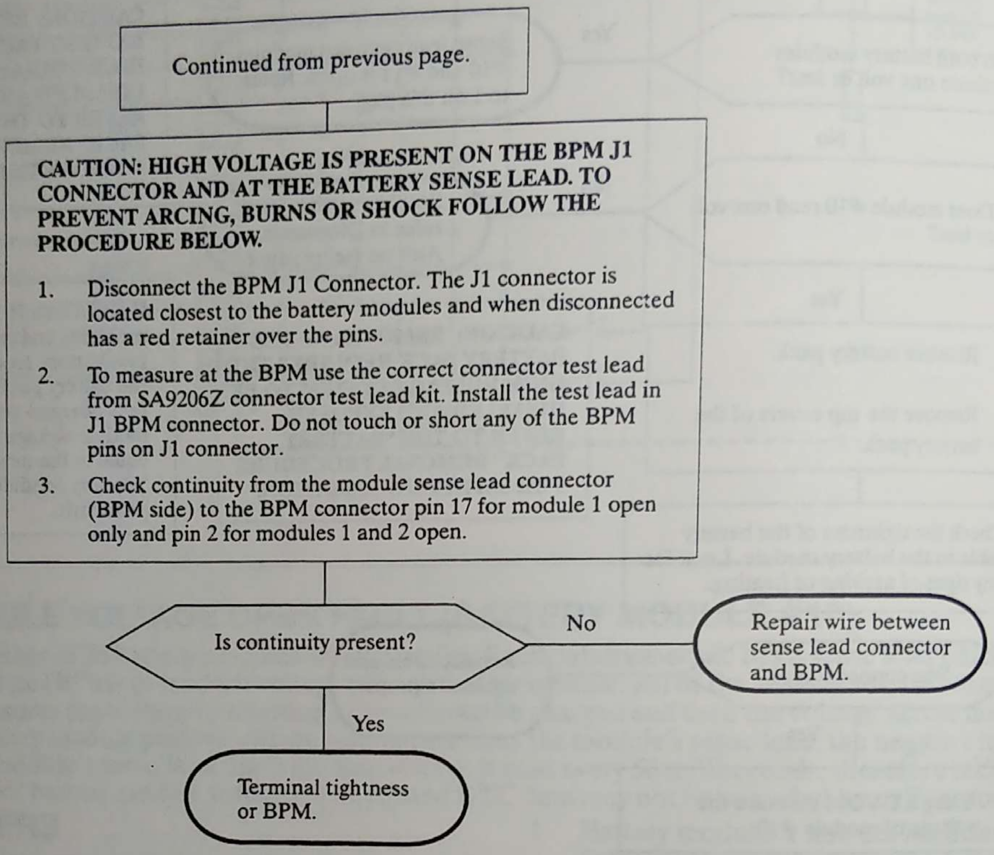
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CS CamScanner

DTC 073
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #10) – CONTINUED



Continued from previous page.

CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

Is continuity present?

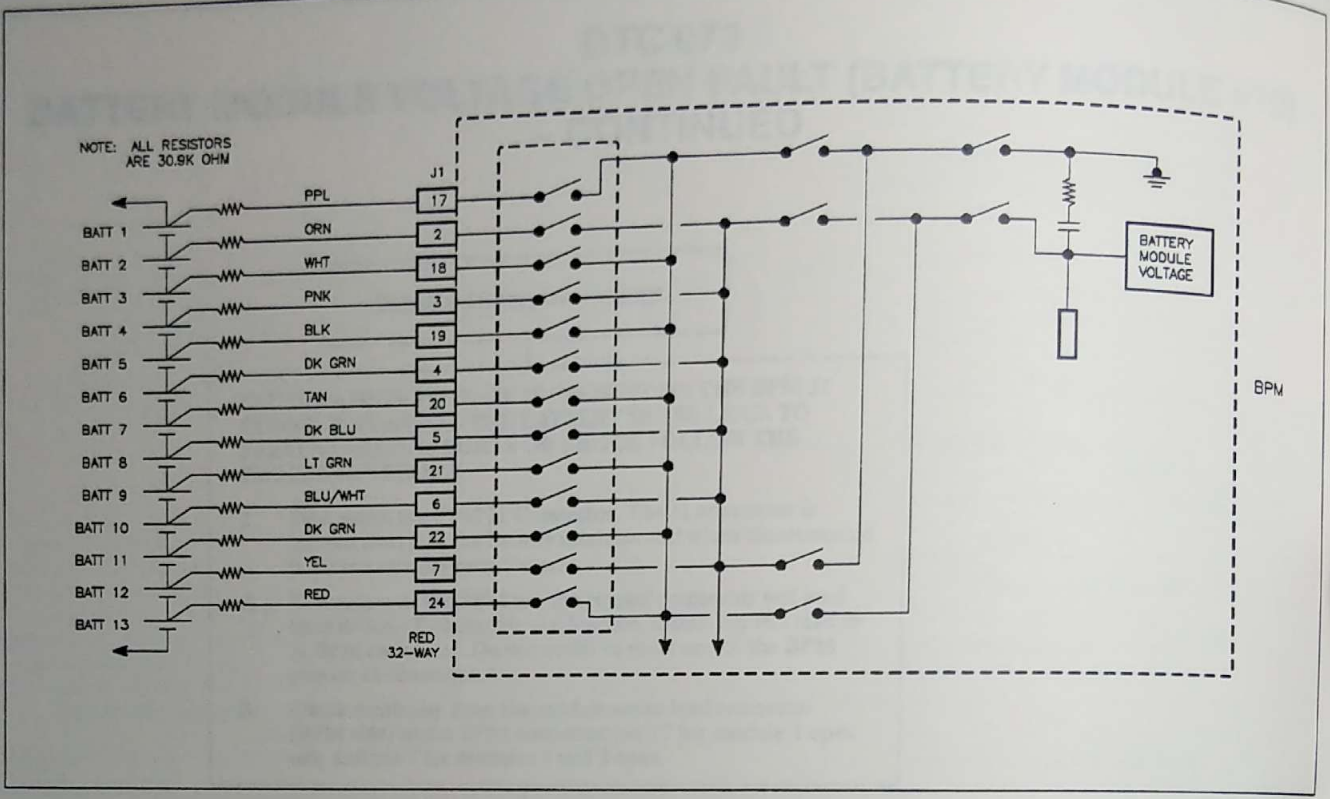
Repair wire between sense lead connector and BPM.

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 075 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #10)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #10: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

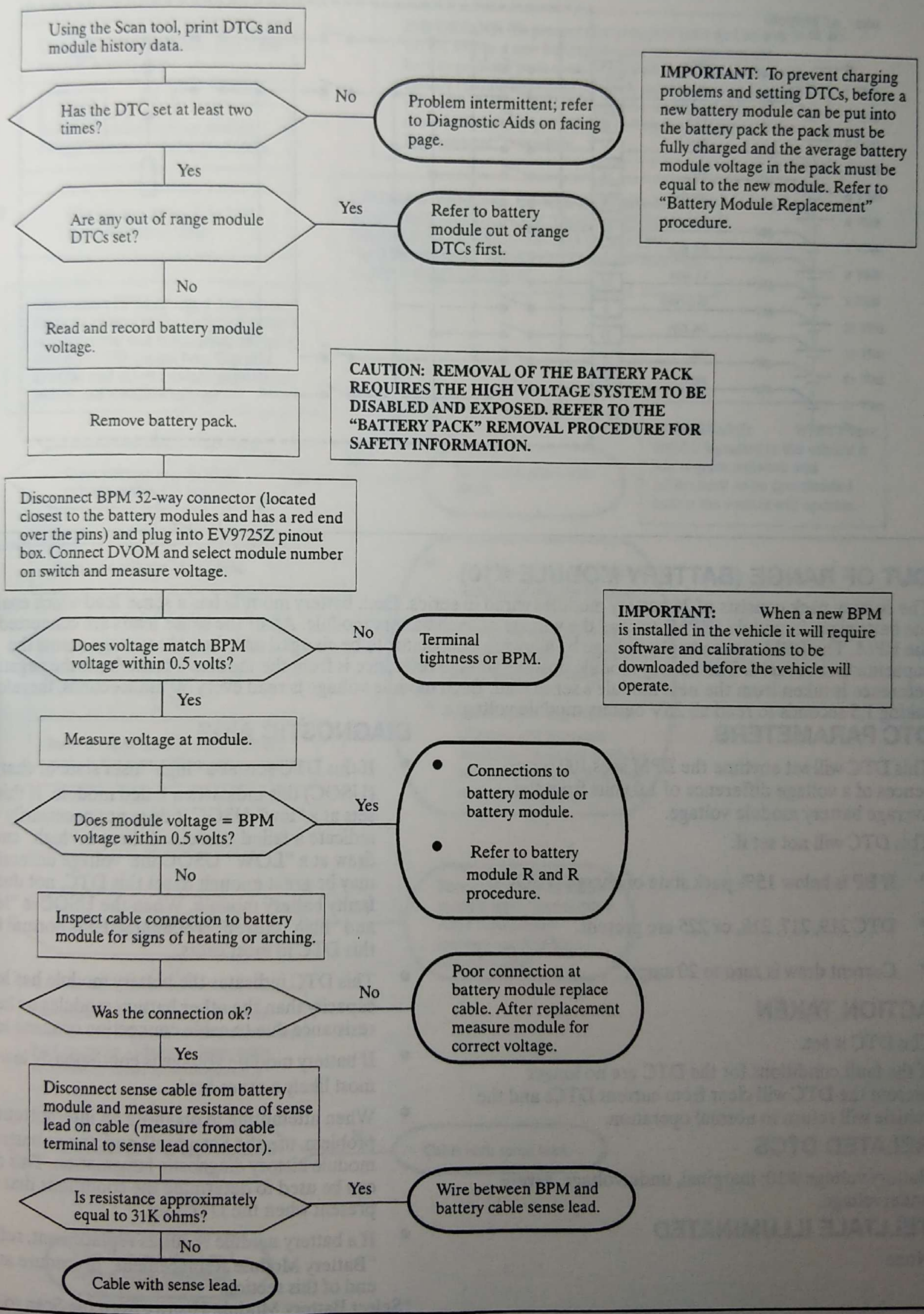
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

DTC 075
MARGINAL (BATTERY MODULE #10)



Using the Scan tool, print DTCs and module history data.

Has the DTC set at least two times?

No

Problem intermittent; refer to Diagnostic Aids on facing page.

Yes

Are any out of range module DTCs set?

Yes

Refer to battery module out of range DTCs first.

No

Read and record battery module voltage.

Remove battery pack.

Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

No

Terminal tightness or BPM.

Yes

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

Yes

- Connections to battery module or battery module.
- Refer to battery module R and R procedure.

No

Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

No

Poor connection at battery module replace cable. After replacement measure module for correct voltage.

Yes

Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).

Is resistance approximately equal to 31K ohms?

Yes

Wire between BPM and battery cable sense lead.

No

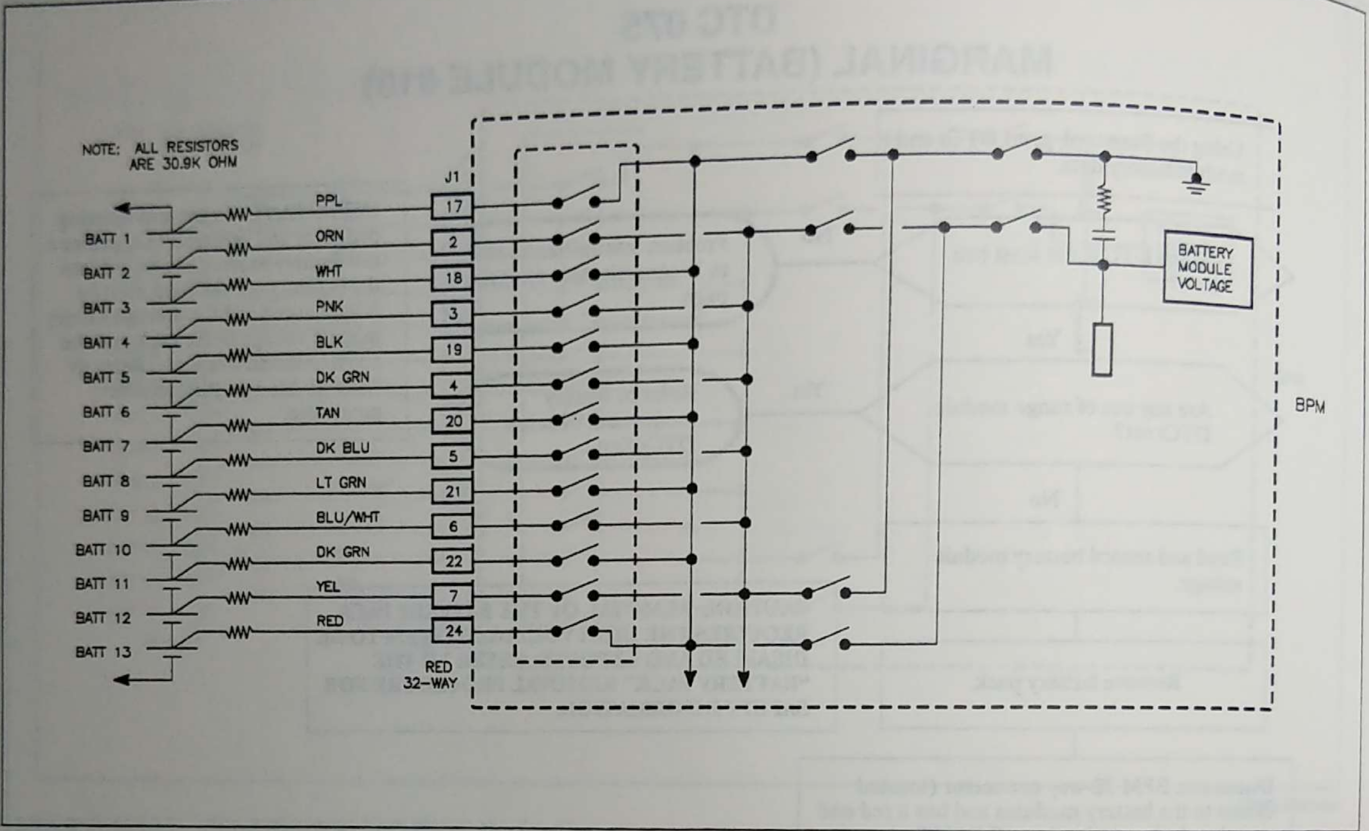
Cable with sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 076 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #10)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery voltage #10: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

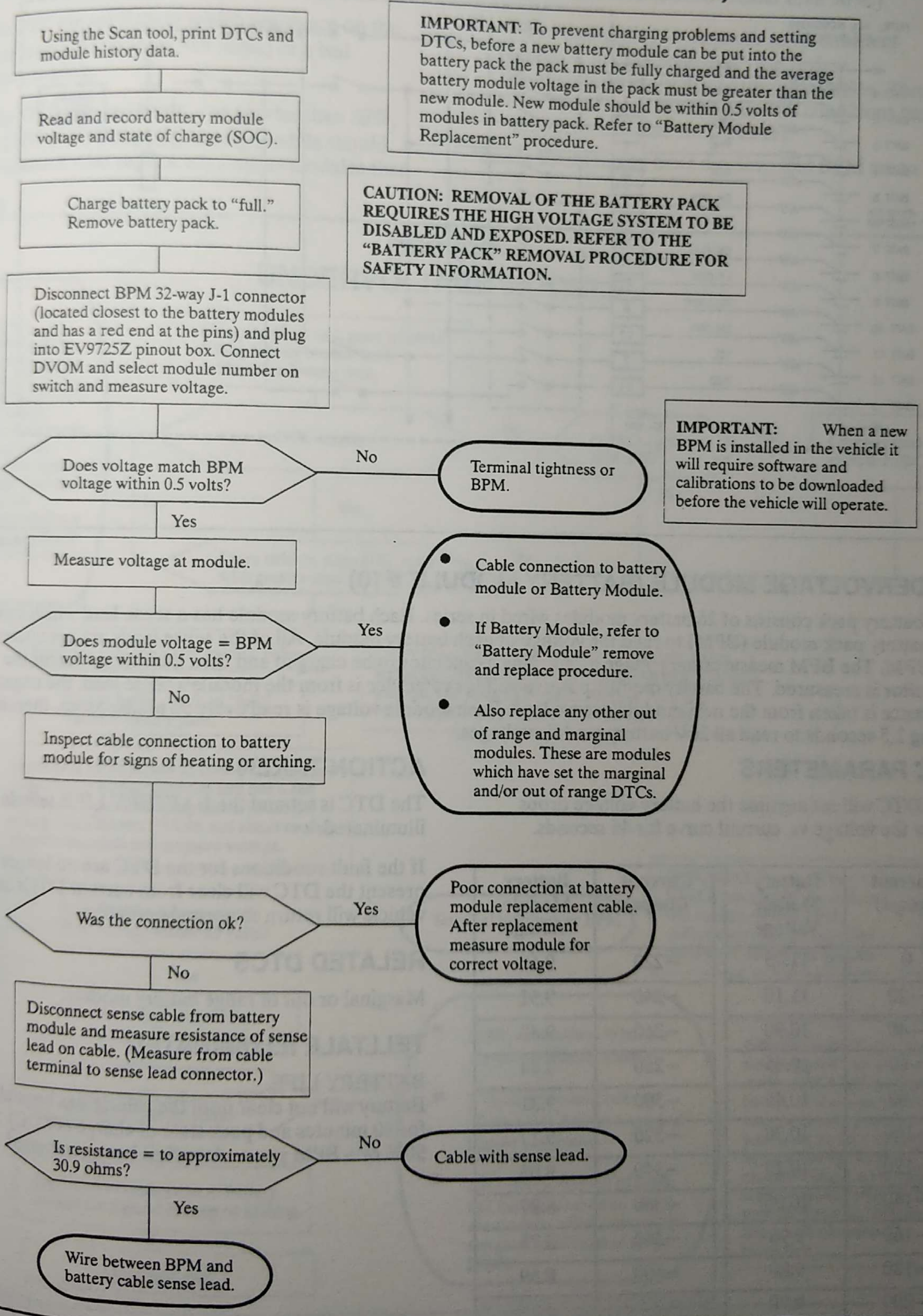
None

DIAGNOSTIC AIDS

- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

*Select Battery Module History from the Scan tool BPM menu.

DTC 076
OUT OF RANGE (BATTERY MODULE #10)



Using the Scan tool, print DTCs and module history data.

Read and record battery module voltage and state of charge (SOC).

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Cable connection to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Poor connection at battery module replacement cable. After replacement measure module for correct voltage.

Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)

Is resistance = to approximately 30.9 ohms?

Cable with sense lead.

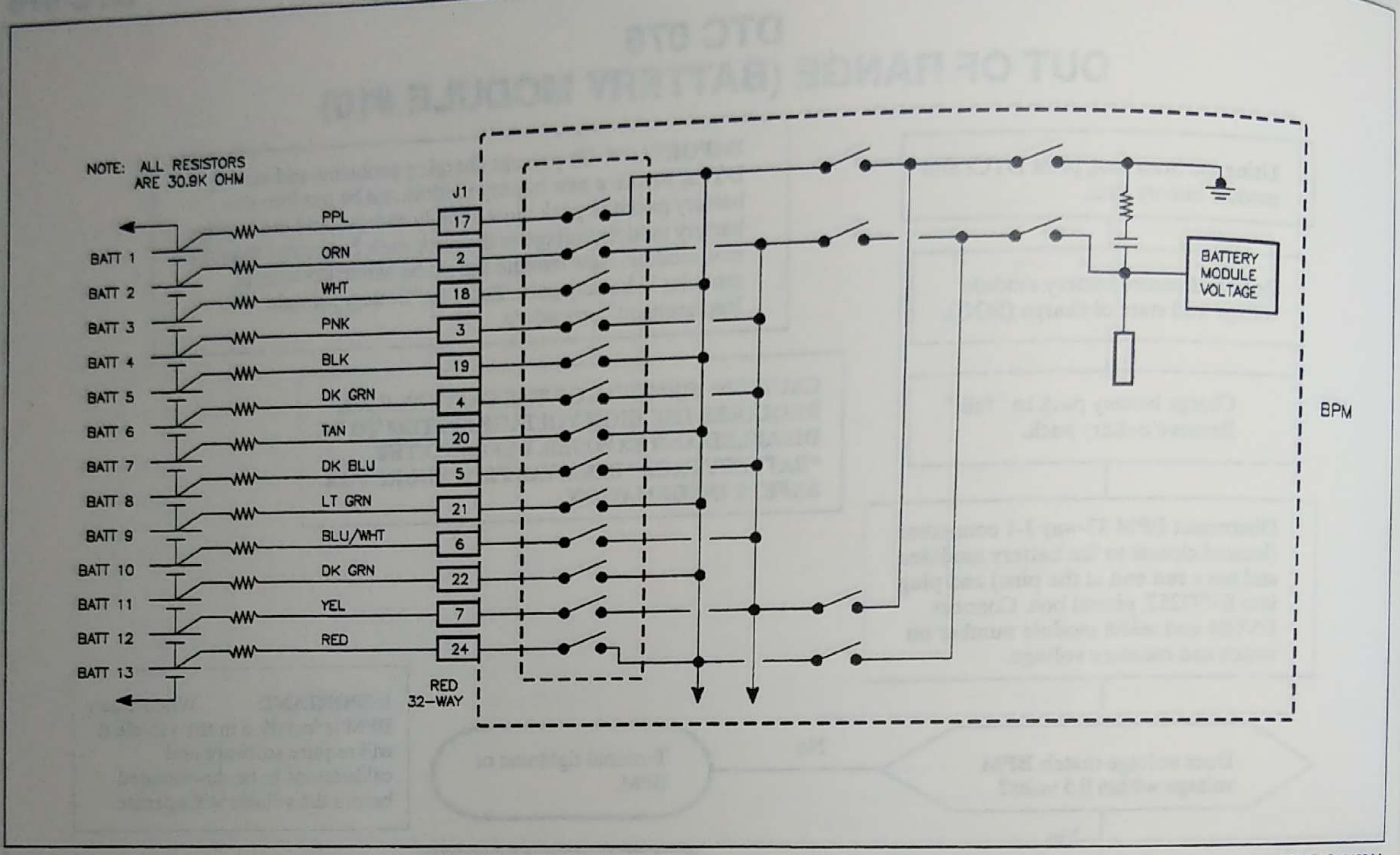
Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 077 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED
32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #10)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage	Current (Amps)	Battery Module Voltage
0	11.75	−220	9.60
−20	11.10	−240	9.52
−40	10.90	−260	9.48
−60	10.65	−280	9.44
−80	10.45	−300	9.31
−100	10.30	−320	9.17
−120	10.15	−340	9.03
−140	10.00	−360	8.87
−160	9.90	−380	8.73
−180	9.80	−400	8.59
−200	9.70		

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

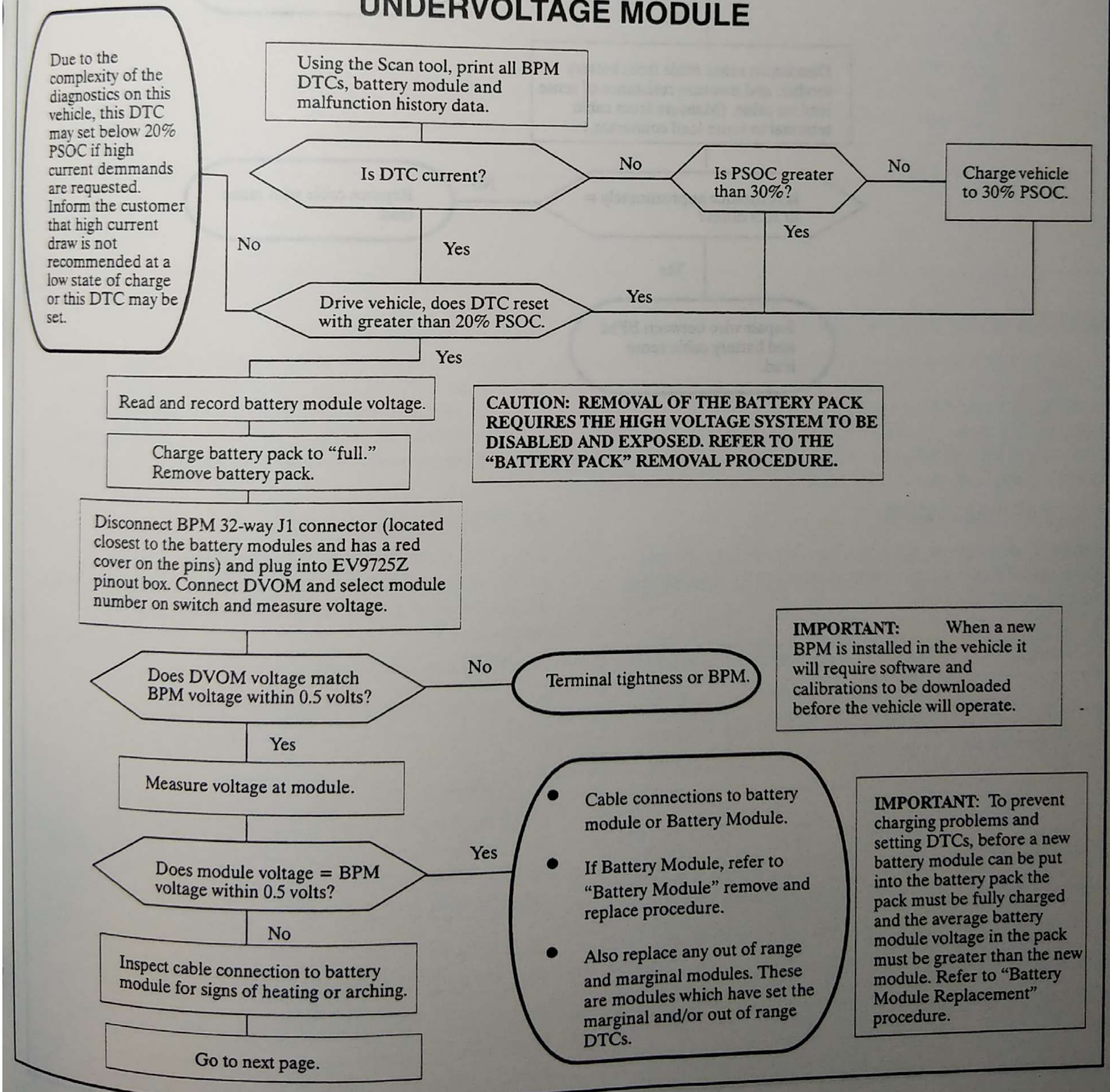
BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below 0% user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 077
UNDERVOLTAGE MODULE



Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

Using the Scan tool, print all BPM DTCs, battery module and malfunction history data.

Is DTC current?

Is PSOC greater than 30%?

Charge vehicle to 30% PSOC.

Drive vehicle, does DTC reset with greater than 20% PSOC.

Read and record battery module voltage.

Charge battery pack to "full." Remove battery pack.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

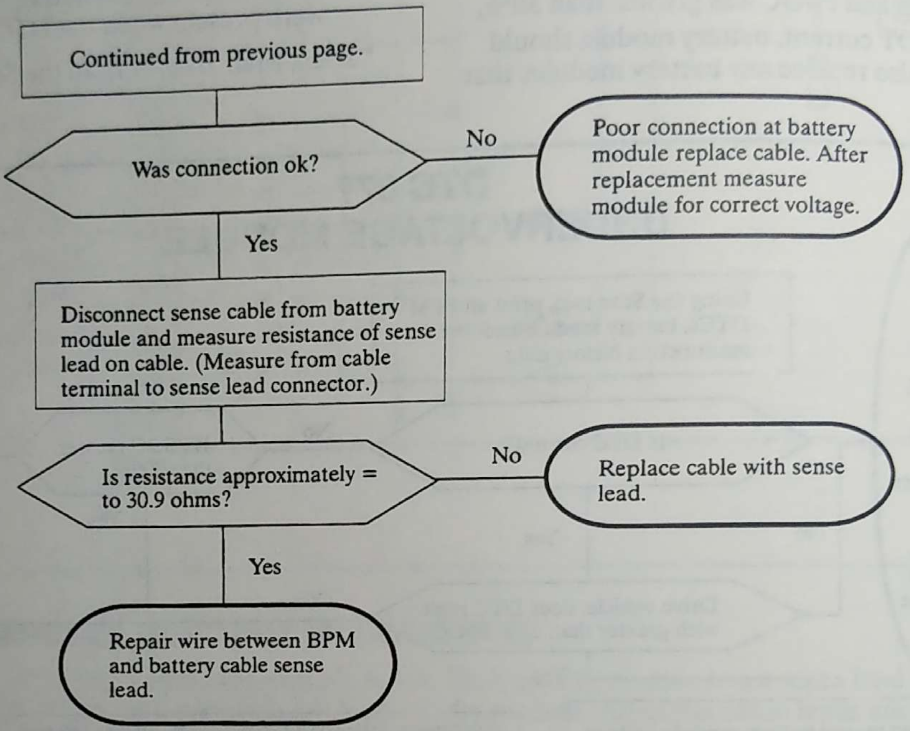
- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

Inspect cable connection to battery module for signs of heating or arching.

Go to next page.

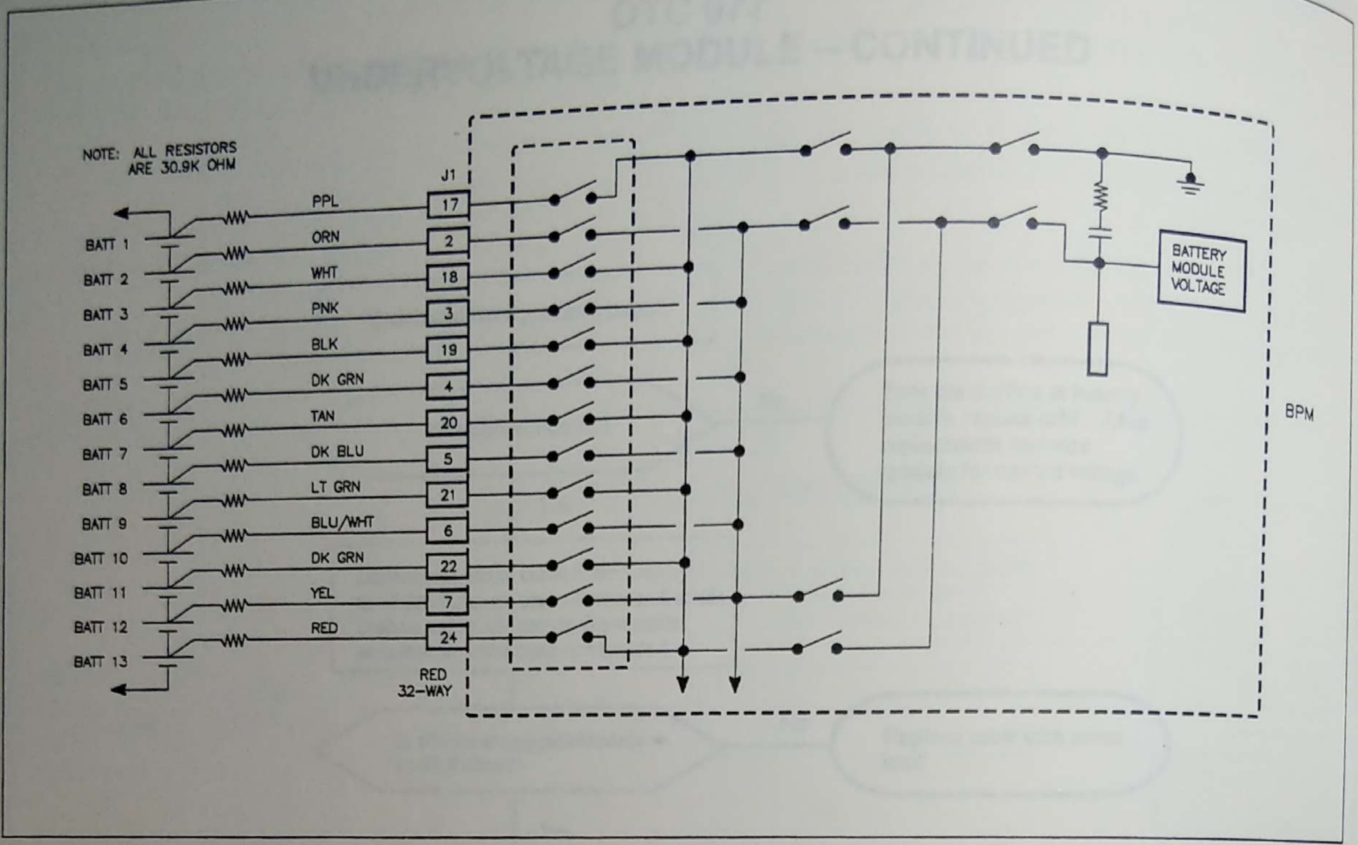
DTC 077
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

CS CamScanner

NOTES

DTC 078 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #10)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

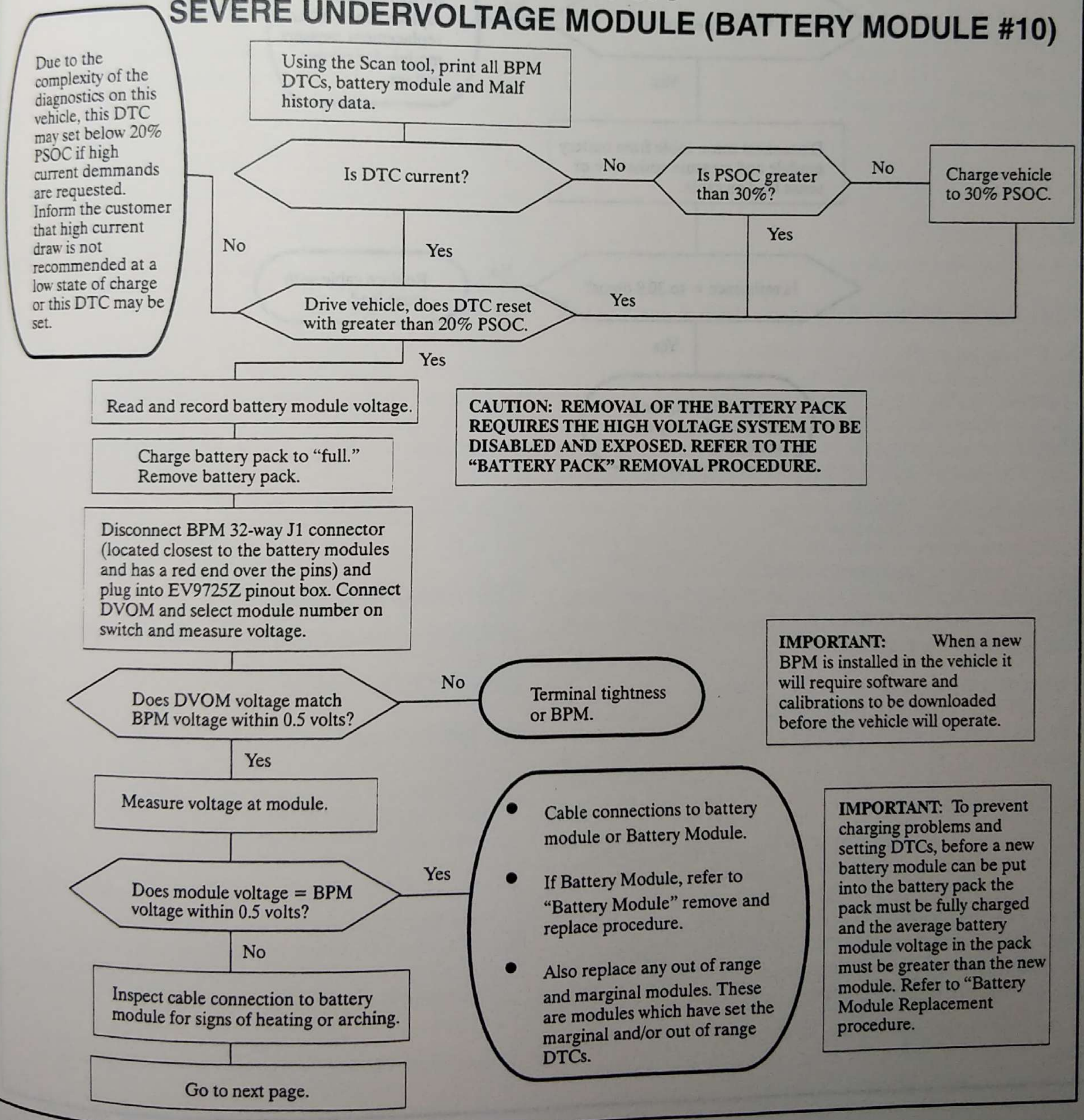
DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches 0 percent user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 078

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #10)

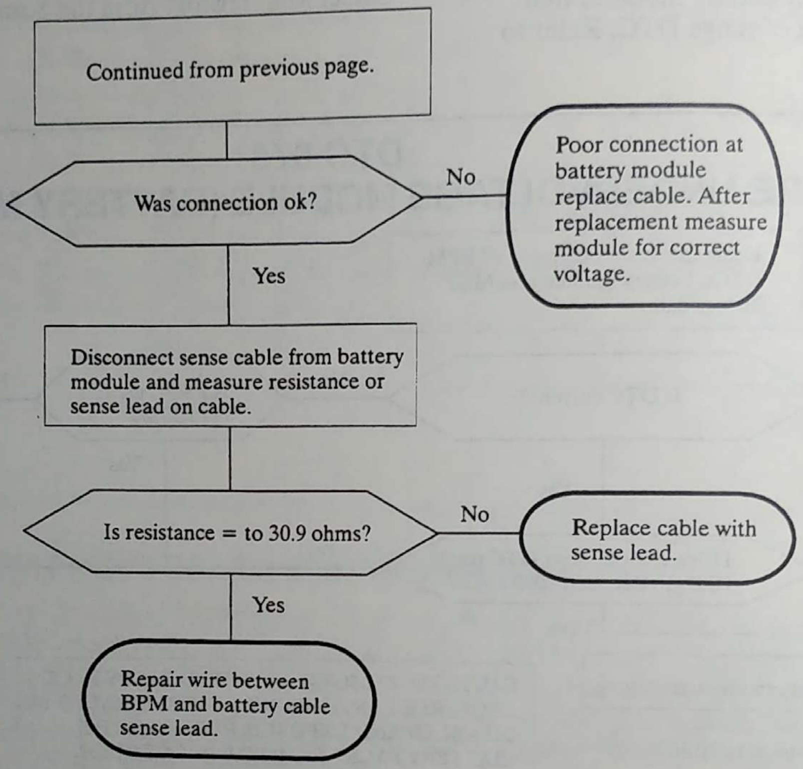

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

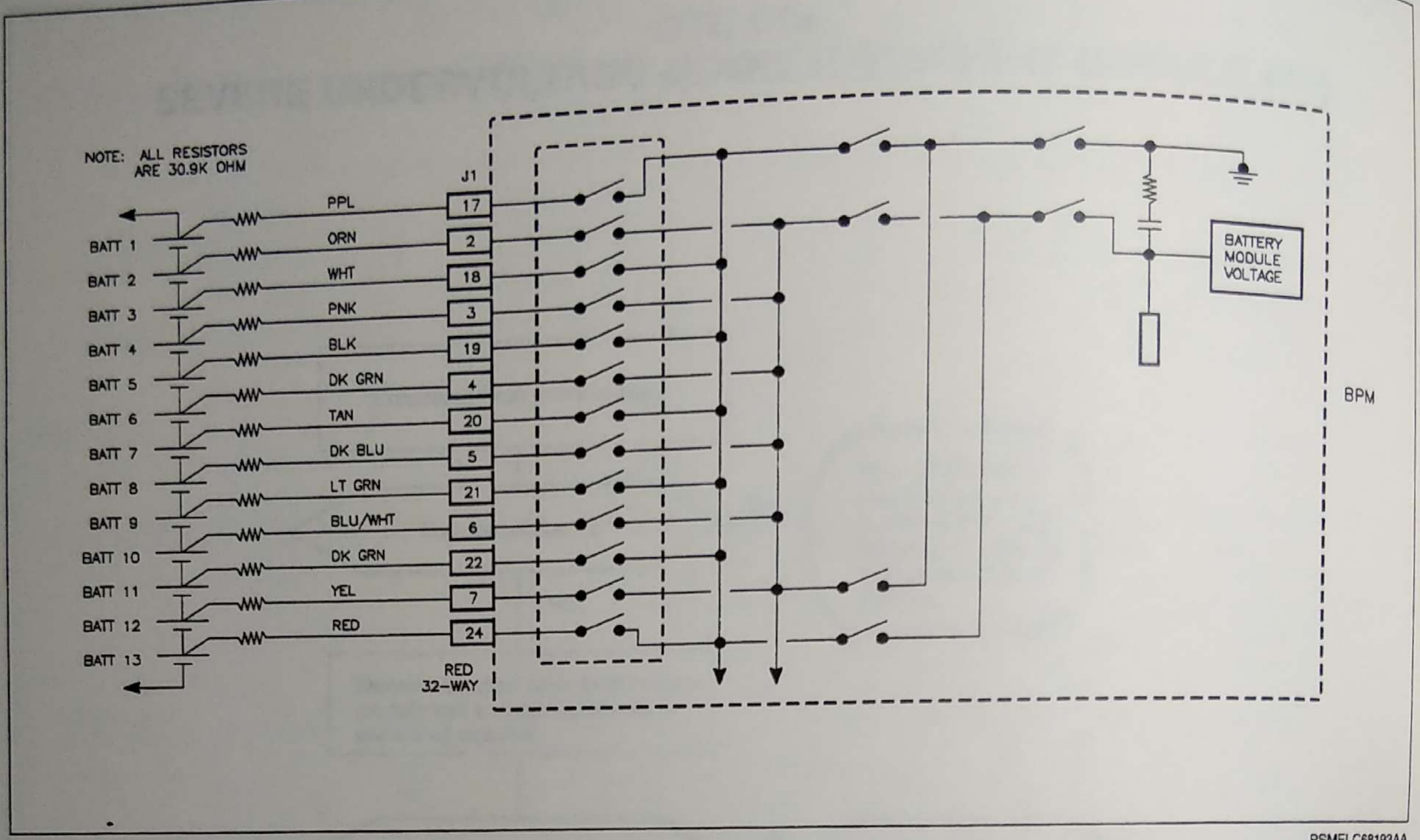
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement procedure.

DTC 078
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #10)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 079 – SEVERE OVERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
J1
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM
PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #10)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

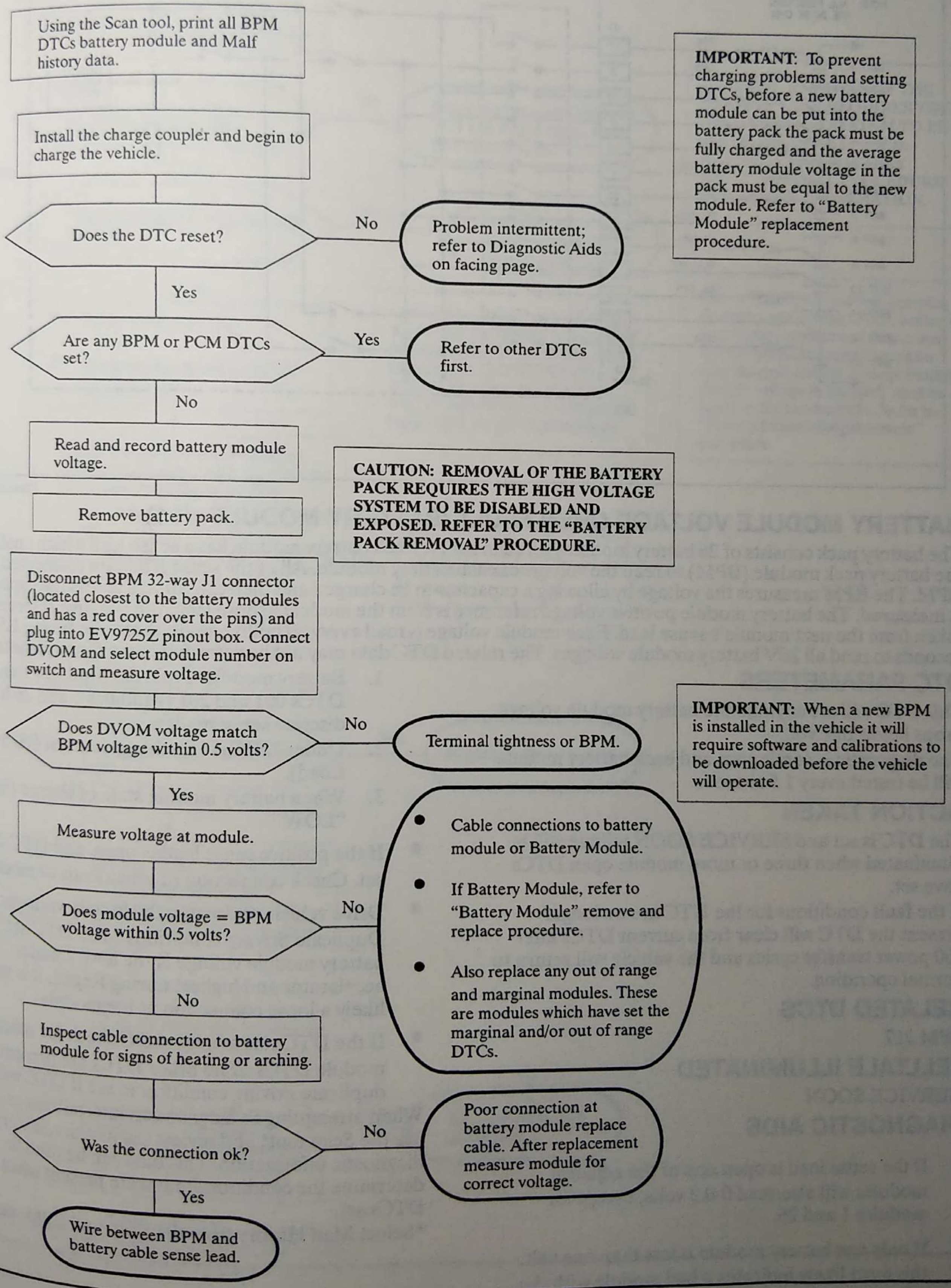
SERVICE NOW and REDUCED PERFORMANCE

DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

DTC 079
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #10)



Using the Scan tool, print all BPM DTCs battery module and Malf history data.

Install the charge coupler and begin to charge the vehicle.

Does the DTC reset?

No

Problem intermittent; refer to Diagnostic Aids on facing page.

Yes

Are any BPM or PCM DTCs set?

Yes

Refer to other DTCs first.

No

Read and record battery module voltage.

Remove battery pack.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

No

Terminal tightness or BPM.

Yes

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

No

- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

No

Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

No

Poor connection at battery module replace cable. After replacement measure module for correct voltage.

Yes

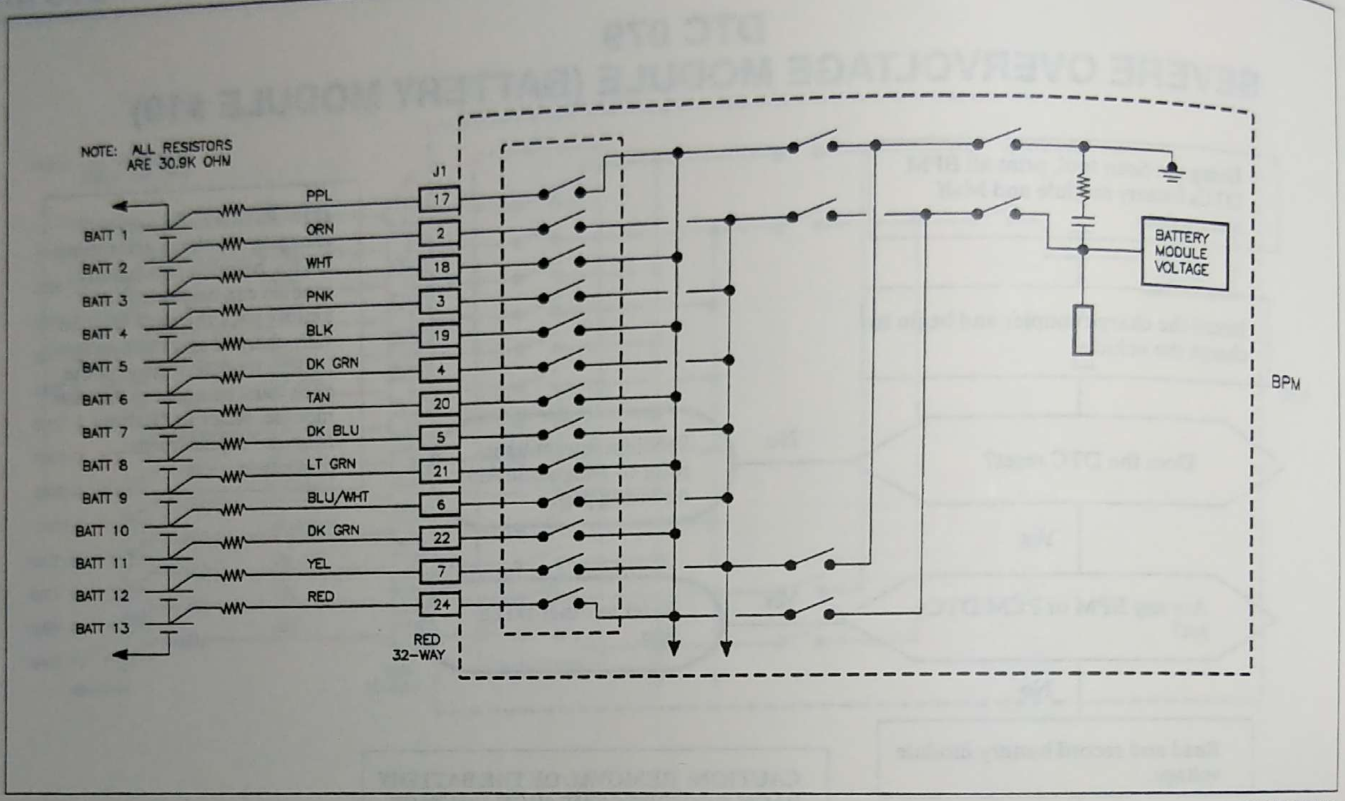
Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 081 – BATTERY MODULE VOLTAGE OPEN FAULT



BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #11)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

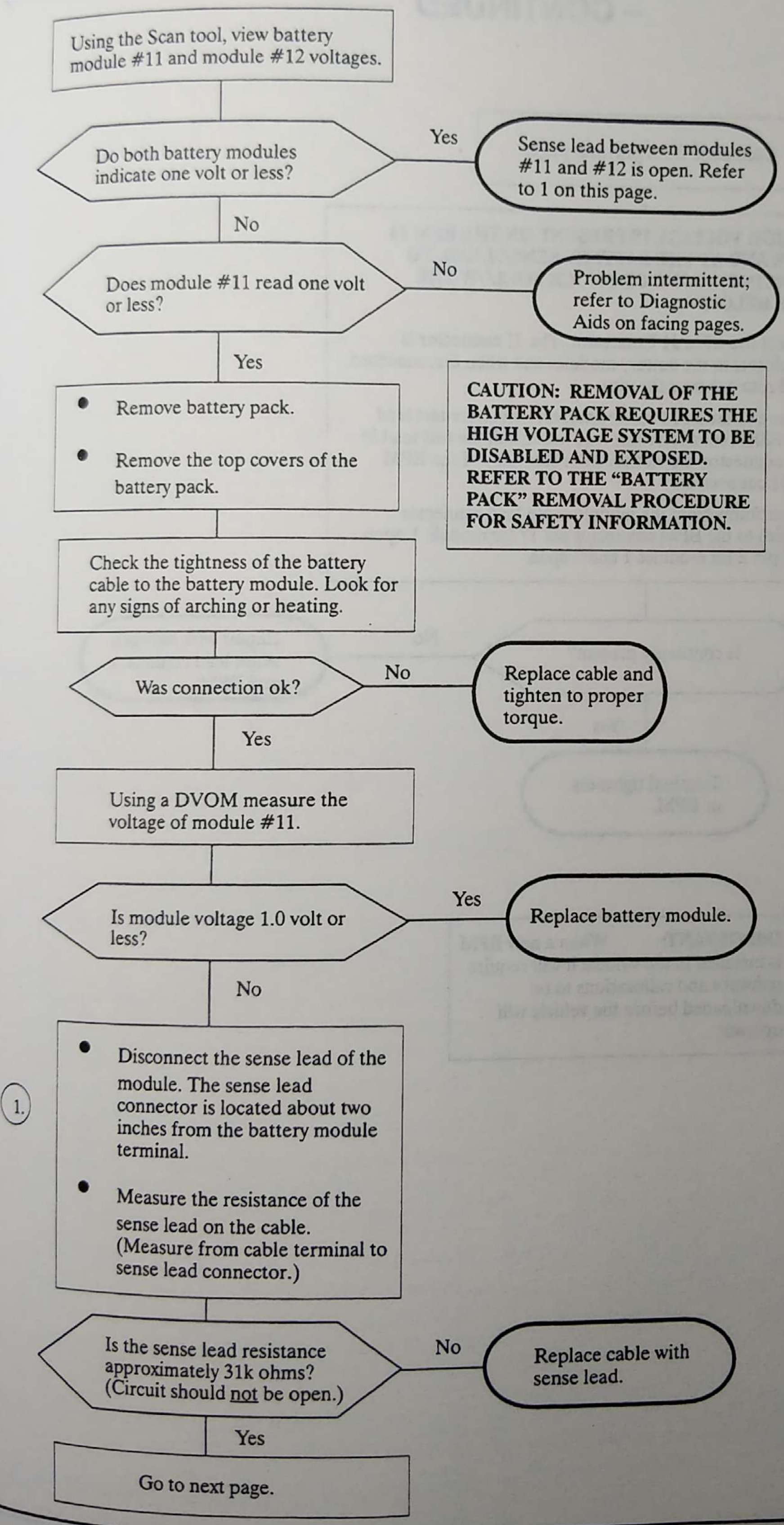
DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:
  1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
  2. Under "HIGH" discharge current (Heavy Load).
  3. When battery module state of charge (SOC) is "LOW."
- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 081
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #11)


Using the Scan tool, view battery module #11 and module #12 voltages.
Do both battery modules indicate one volt or less?
Yes
Sense lead between modules #11 and #12 is open. Refer to 1 on this page.
No
Does module #11 read one volt or less?
No
Problem intermittent; refer to Diagnostic Aids on facing pages.
Yes
Remove battery pack.
Remove the top covers of the battery pack.
Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.
Was connection ok?
No
Replace cable and tighten to proper torque.
Yes
Using a DVOM measure the voltage of module #11.
Is module voltage 1.0 volt or less?
Yes
Replace battery module.
No
1.
Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)
Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)
No
Replace cable with sense lead.
Yes
Go to next page.

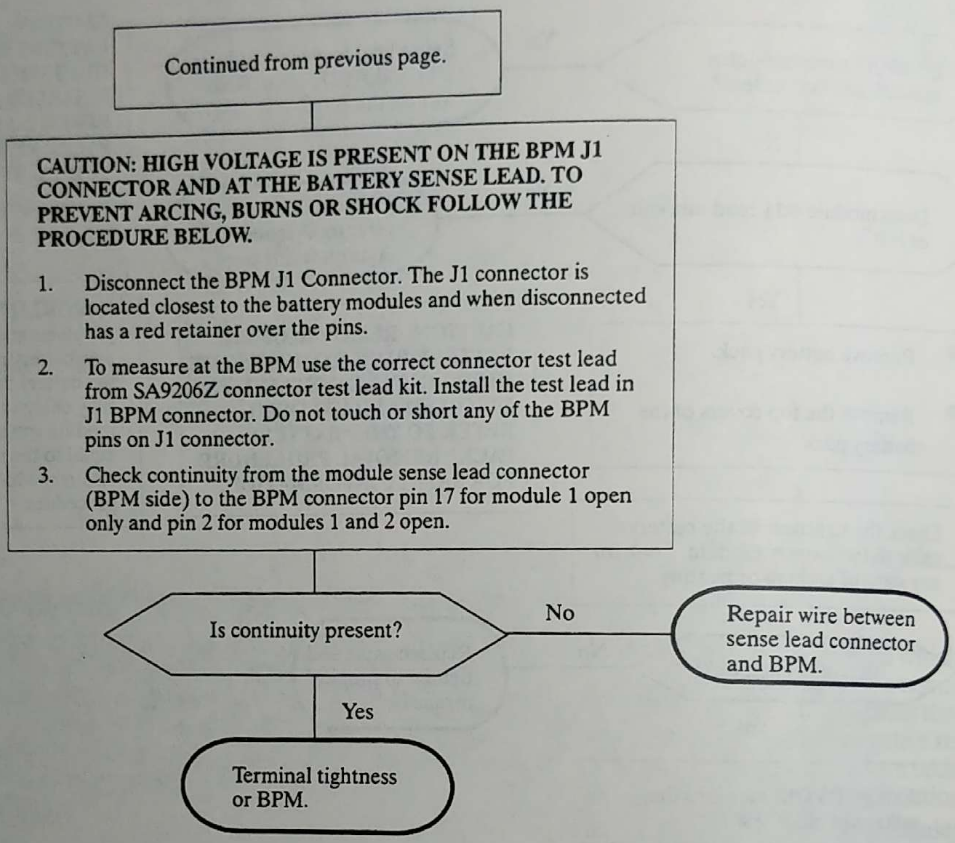
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 081

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #11) – CONTINUED



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CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

Is continuity present?

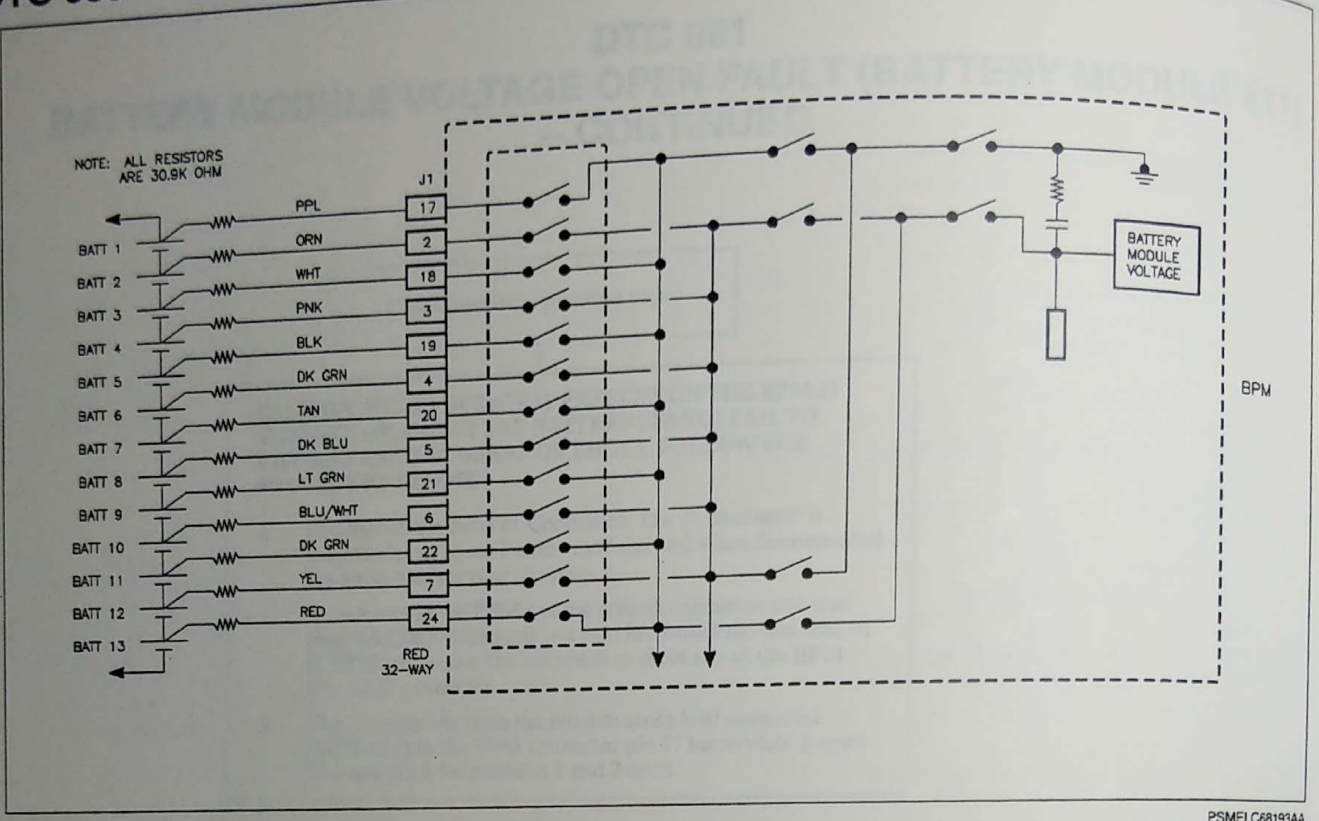
No: Repair wire between sense lead connector and BPM.

Yes: Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 083 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #11)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #11: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

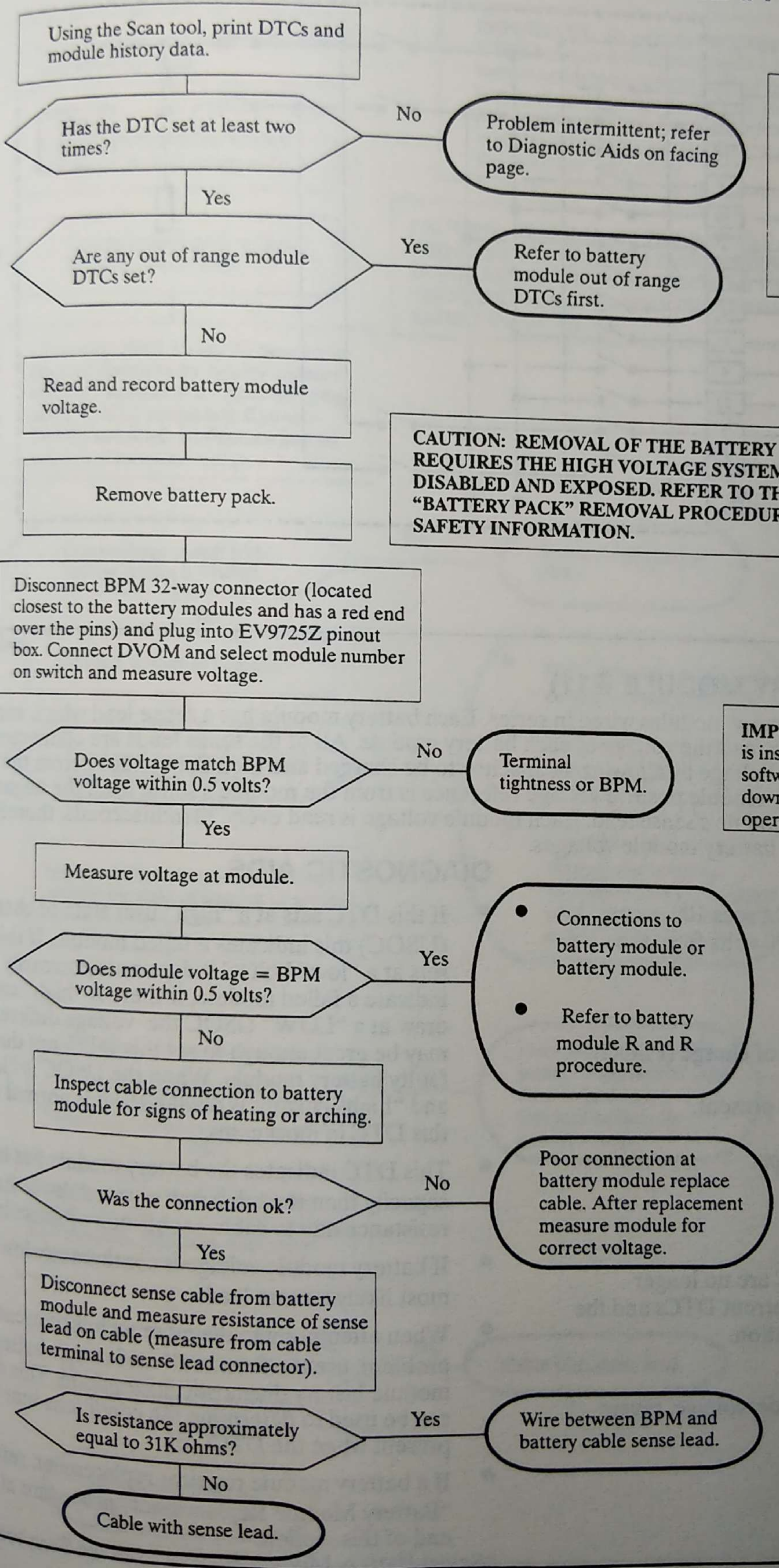
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

DTC 083
MARGINAL (BATTERY MODULE #11)



Using the Scan tool, print DTCs and module history data.

Has the DTC set at least two times?
- No: Problem intermittent; refer to Diagnostic Aids on facing page.
- Yes: Are any out of range module DTCs set?
  - Yes: Refer to battery module out of range DTCs first.
  - No: Read and record battery module voltage.

Remove battery pack.

Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?
- No: Terminal tightness or BPM.
- Yes: Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?
- Yes:
  - Connections to battery module or battery module.
  - Refer to battery module R and R procedure.
- No: Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?
- No: Poor connection at battery module replace cable. After replacement measure module for correct voltage.
- Yes: Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).

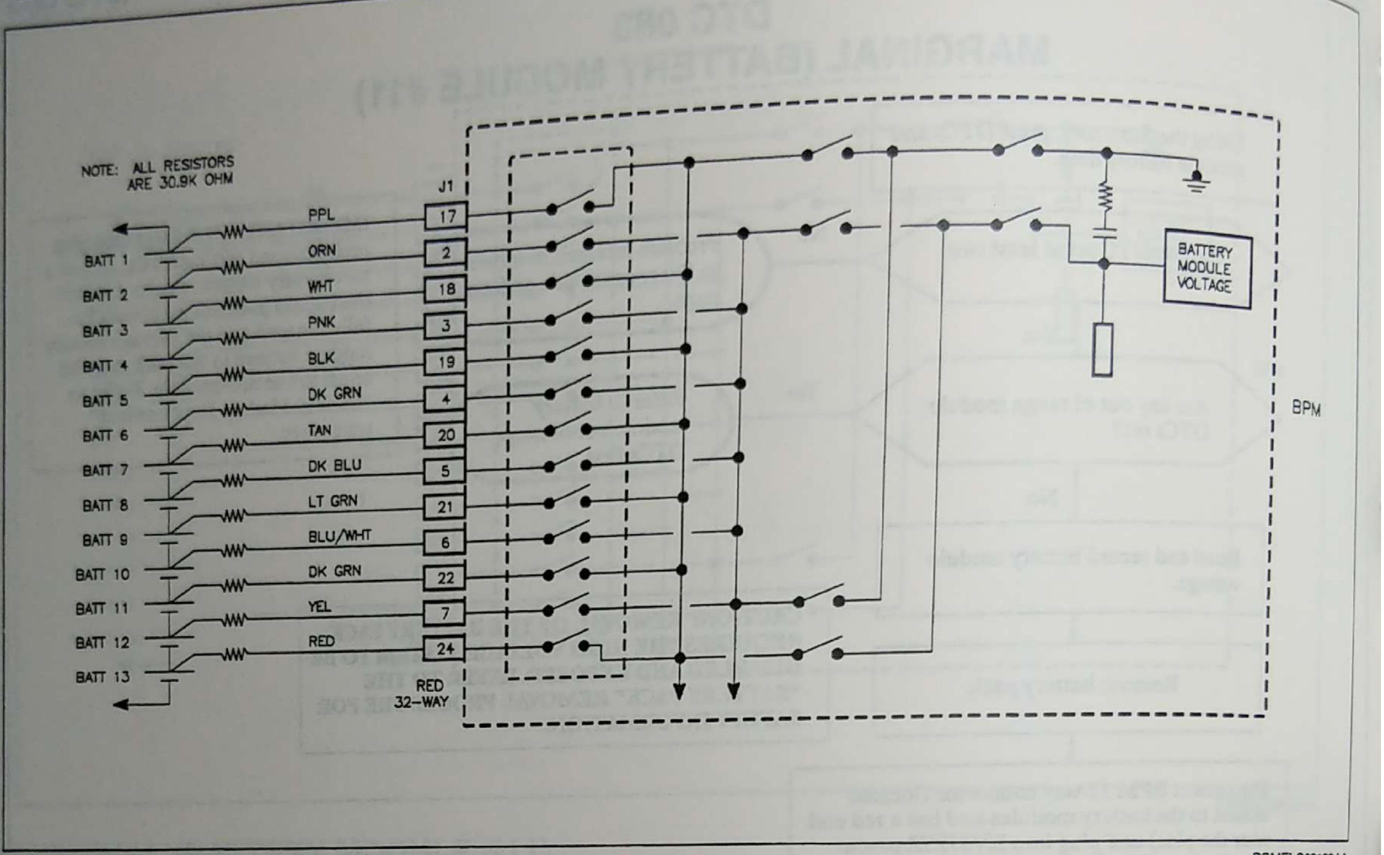
Is resistance approximately equal to 31K ohms?
- Yes: Wire between BPM and battery cable sense lead.
- No: Cable with sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 084 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #11)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #11: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

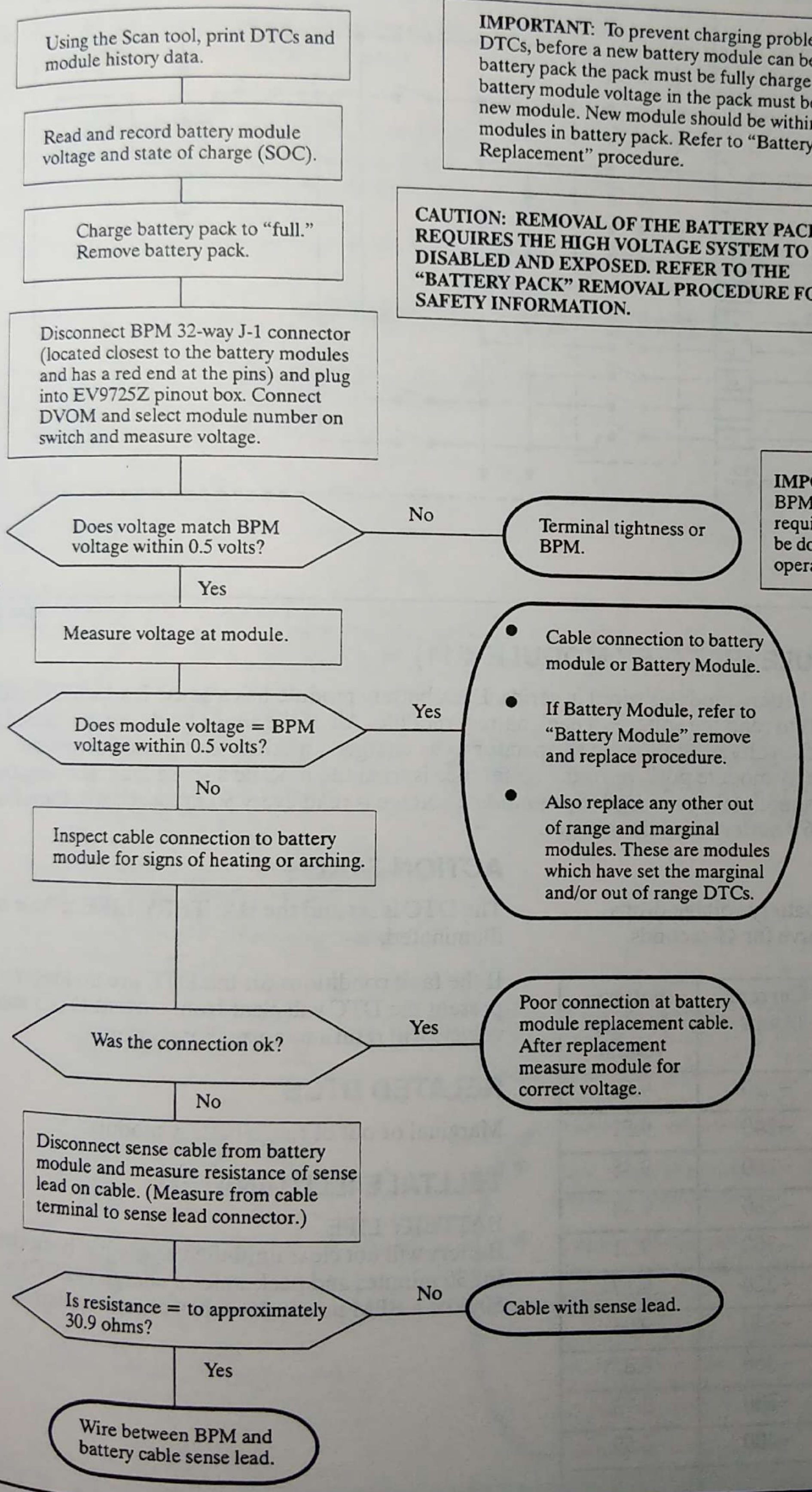
*Select Battery Module History from the Scan tool BPM menu.

DTC 084
OUT OF RANGE (BATTERY MODULE #11)

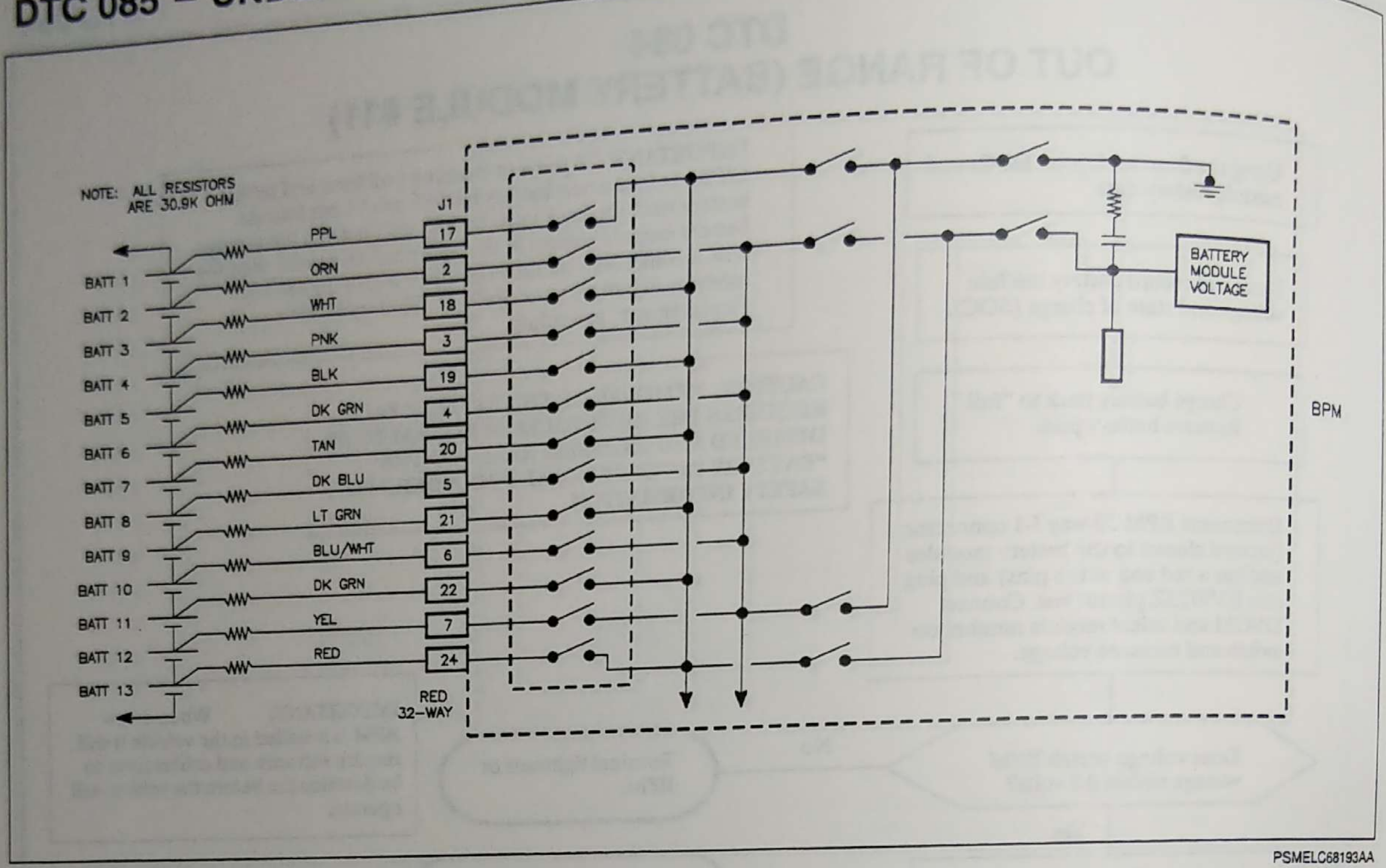
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.


Using the Scan tool, print DTCs and module history data.
Read and record battery module voltage and state of charge (SOC).
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Cable connection to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
Yes
Poor connection at battery module replacement cable. After replacement measure module for correct voltage.
No
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance = to approximately 30.9 ohms?
No
Cable with sense lead.
Yes
Wire between BPM and battery cable sense lead.

DTC 085 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
J1
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32–WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #11)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage
0	11.75
−20	11.10
−40	10.90
−60	10.65
−80	10.45
−100	10.30
−120	10.15
−140	10.00
−160	9.90
−180	9.80
−200	9.70
−220	9.60
−240	9.52
−260	9.48
−280	9.44
−300	9.31
−320	9.17
−340	9.03
−360	8.87
−380	8.73
−400	8.59

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

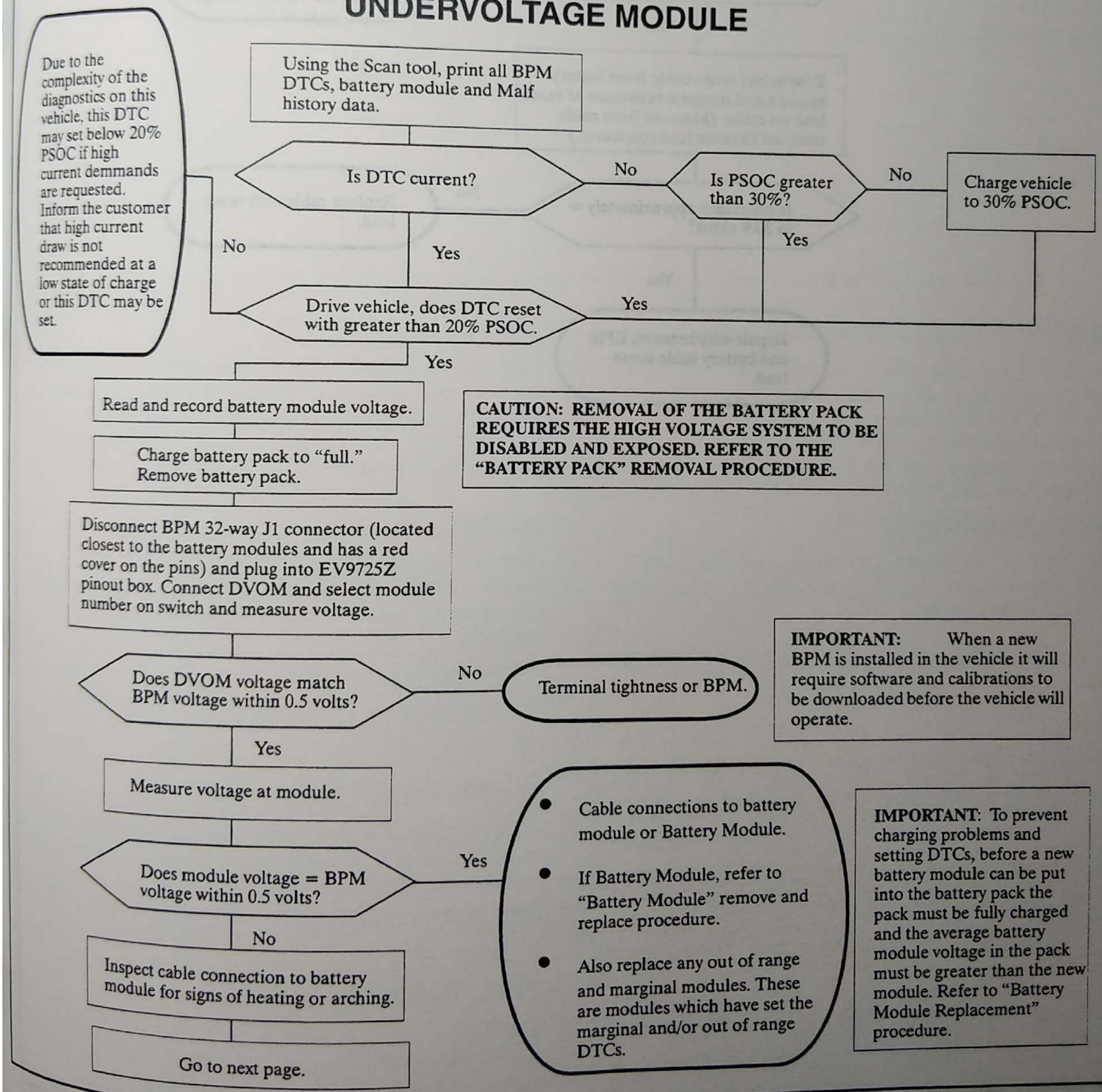
BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below 0% user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 085
UNDERVOLTAGE MODULE



Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

Using the Scan tool, print all BPM DTCs, battery module and Malf history data.

Is DTC current?

Is PSOC greater than 30%?

Charge vehicle to 30% PSOC.

Drive vehicle, does DTC reset with greater than 20% PSOC.

Read and record battery module voltage.

Charge battery pack to "full." Remove battery pack.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

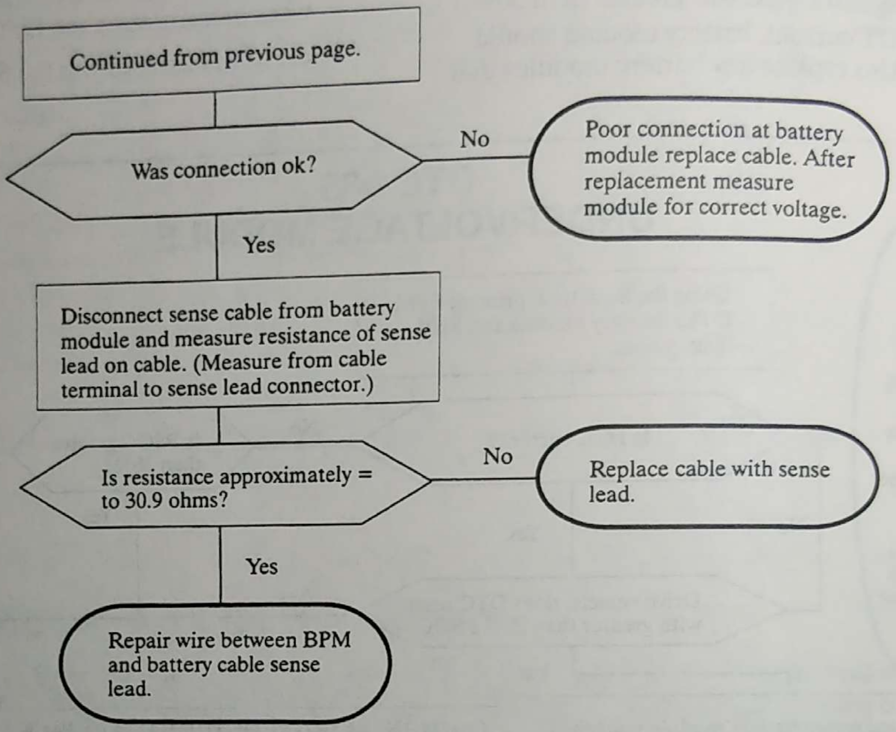
- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

Inspect cable connection to battery module for signs of heating or arching.

Go to next page.

DTC 085
UNDERVOLTAGE MODULE – CONTINUED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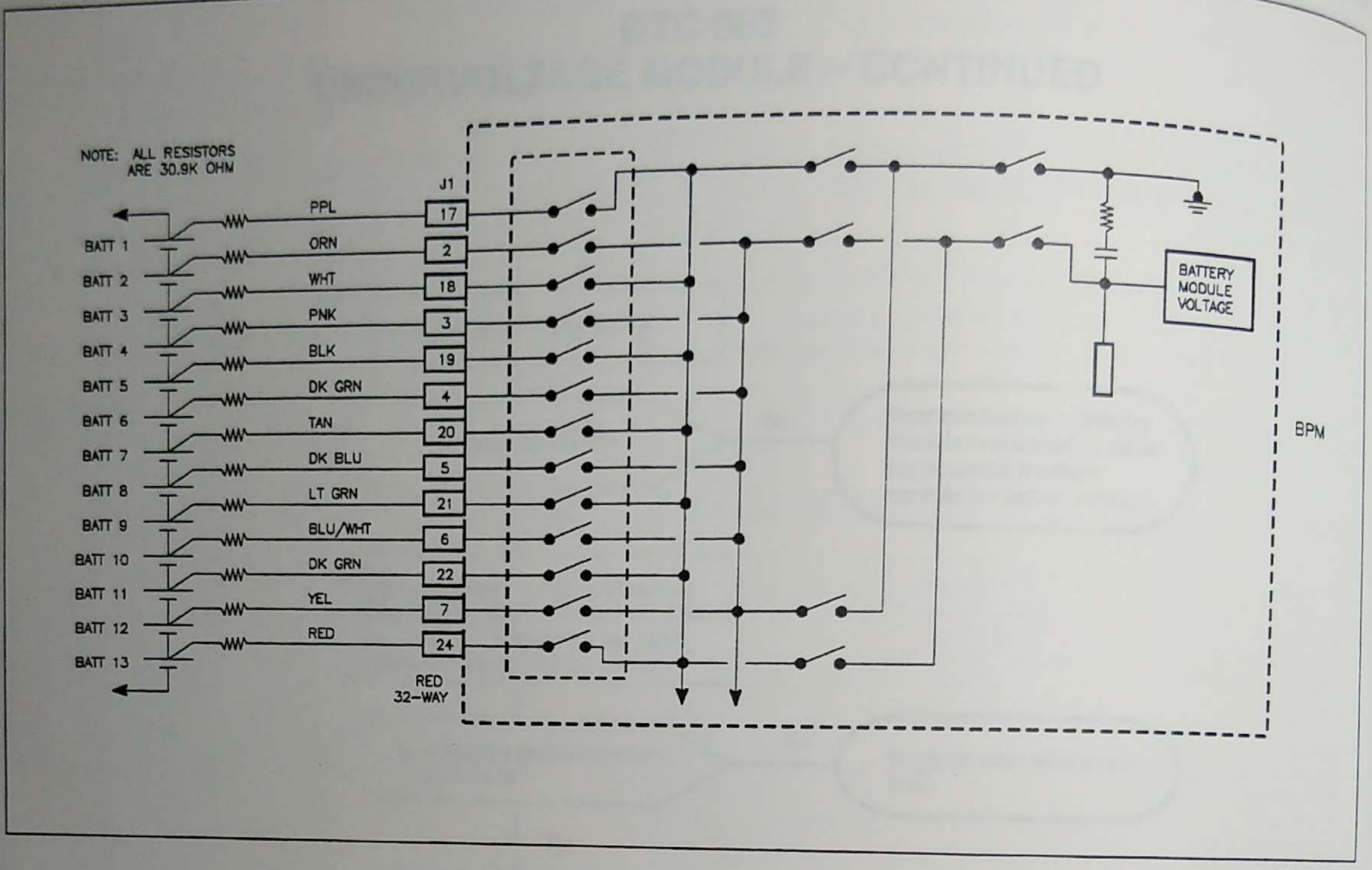
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 086 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS
ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED
32-WAY
BATTERY
MODULE
VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #11)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

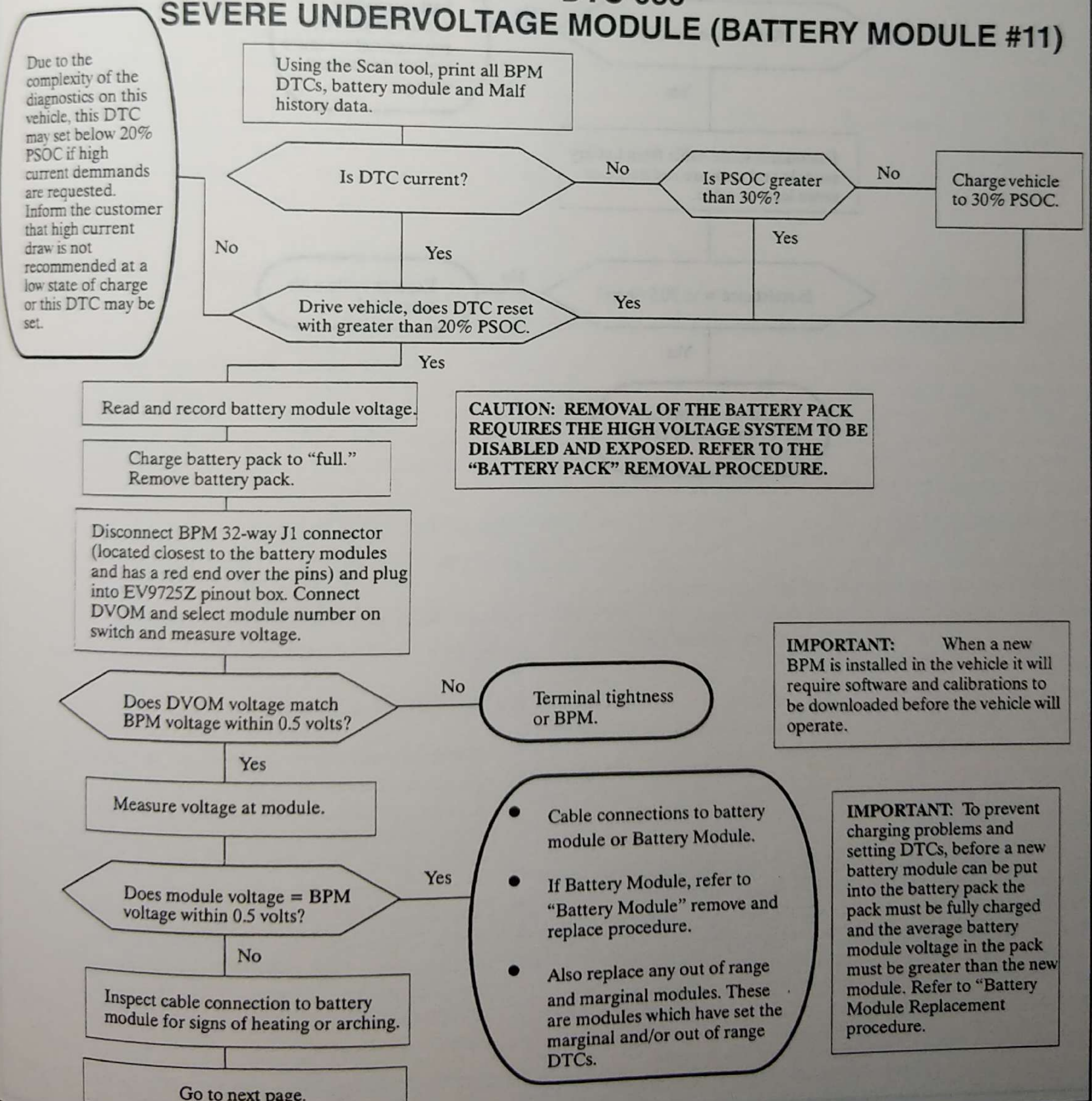
Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches zero percent user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 086
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #11)


Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

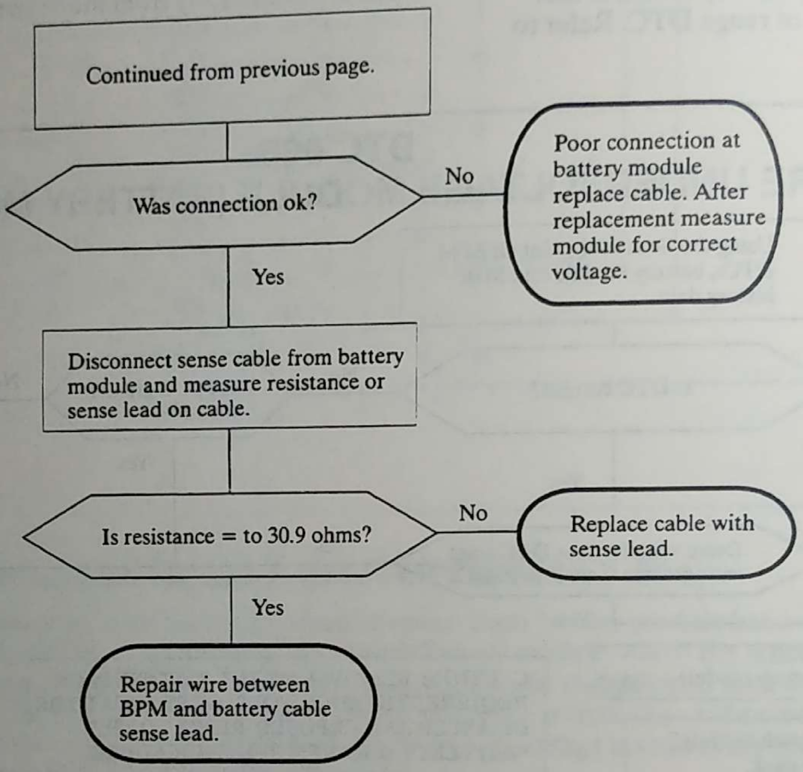
Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

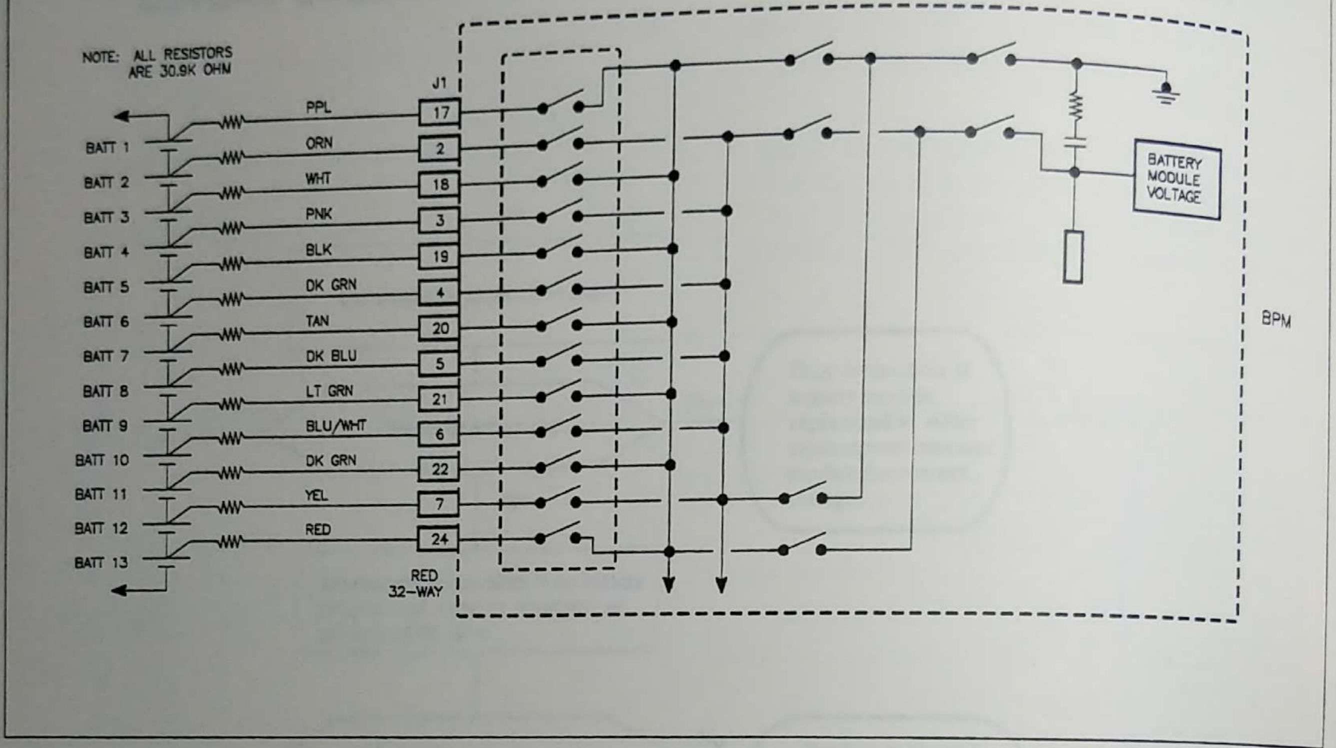
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement procedure.

DTC 086
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #11)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 087 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #11)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

SERVICE NOW and REDUCED PERFORMANCE

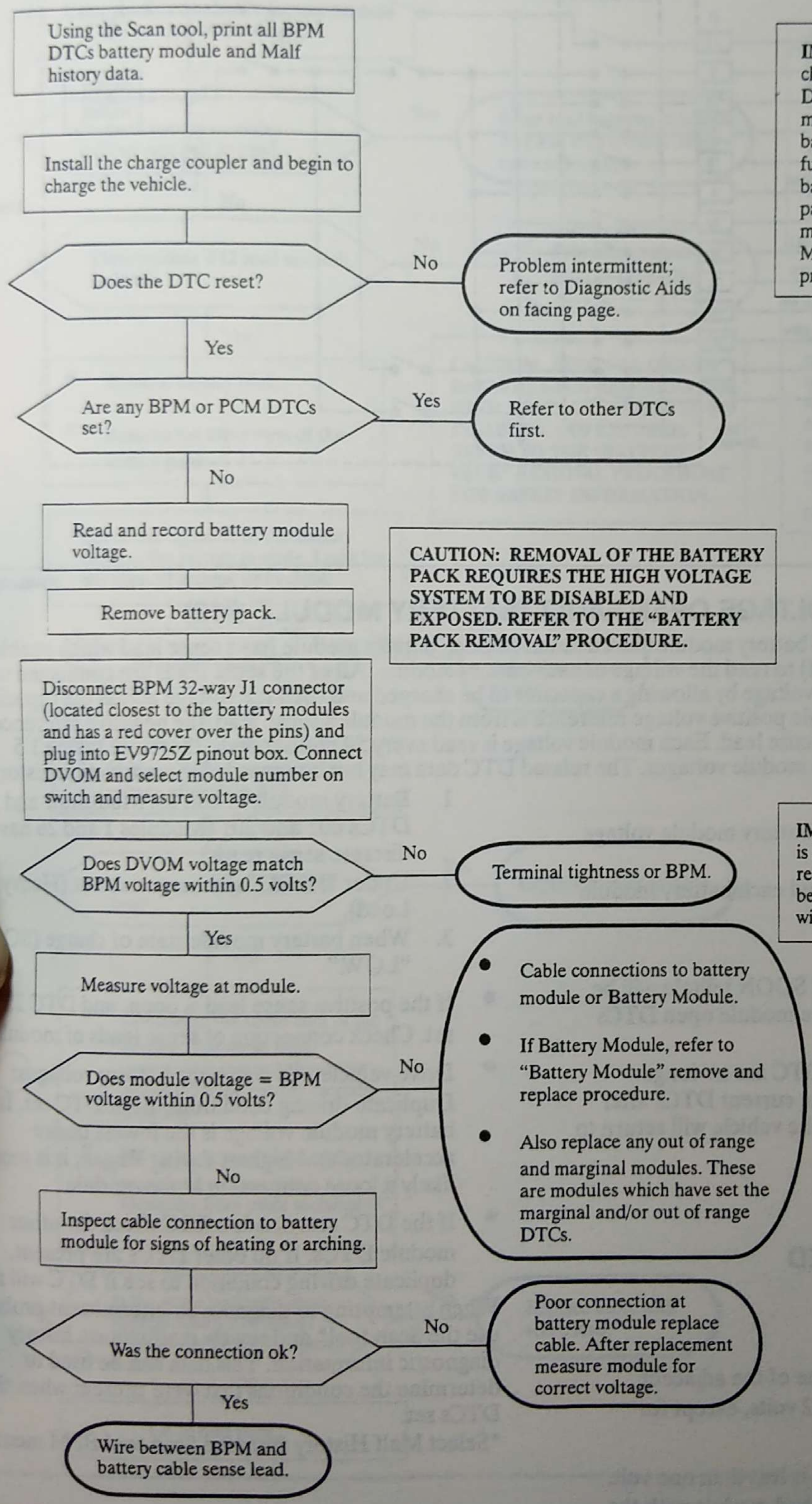
DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

DTC 087
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #11)

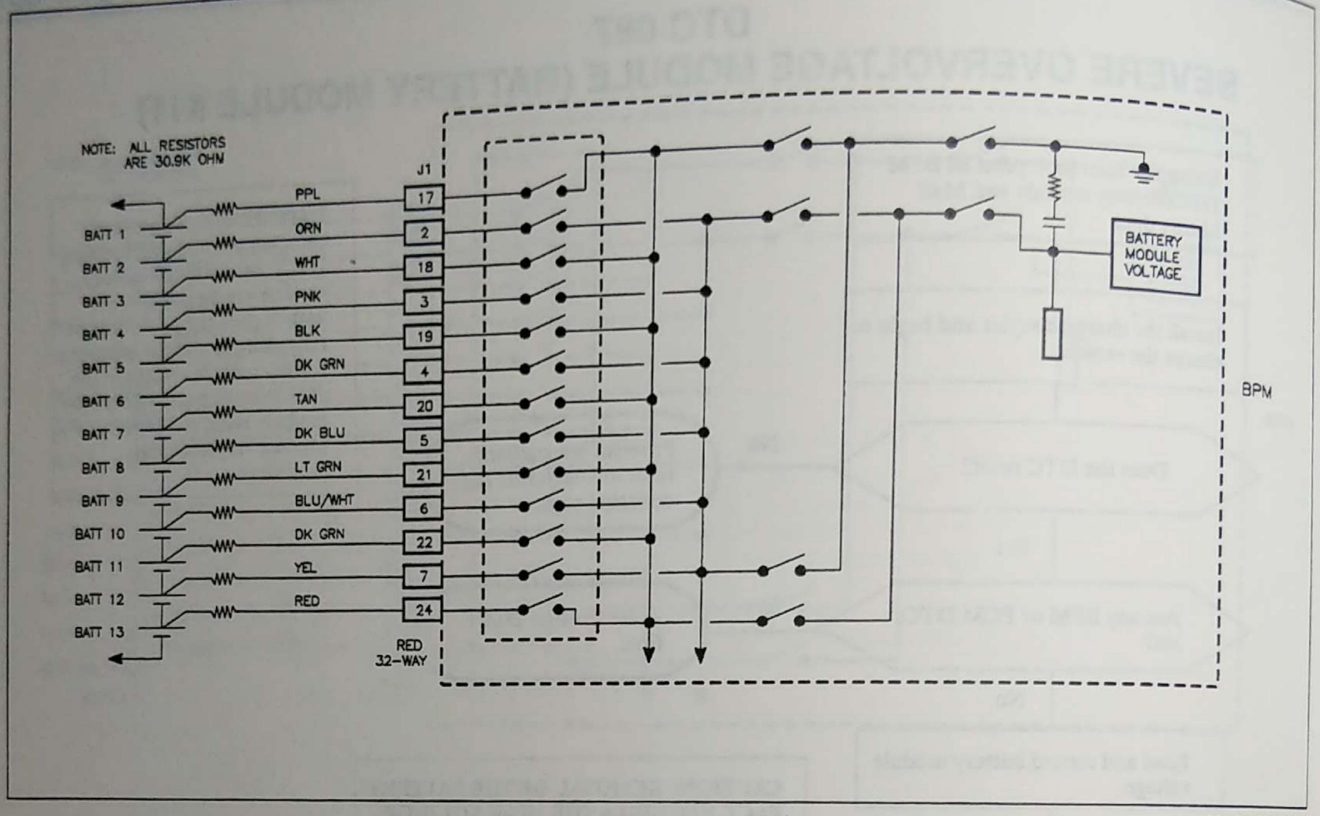
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.


Using the Scan tool, print all BPM DTCs battery module and Malf history data.
Install the charge coupler and begin to charge the vehicle.
Does the DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any BPM or PCM DTCs set?
Yes
Refer to other DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
No
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Wire between BPM and battery cable sense lead.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 089 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #12)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

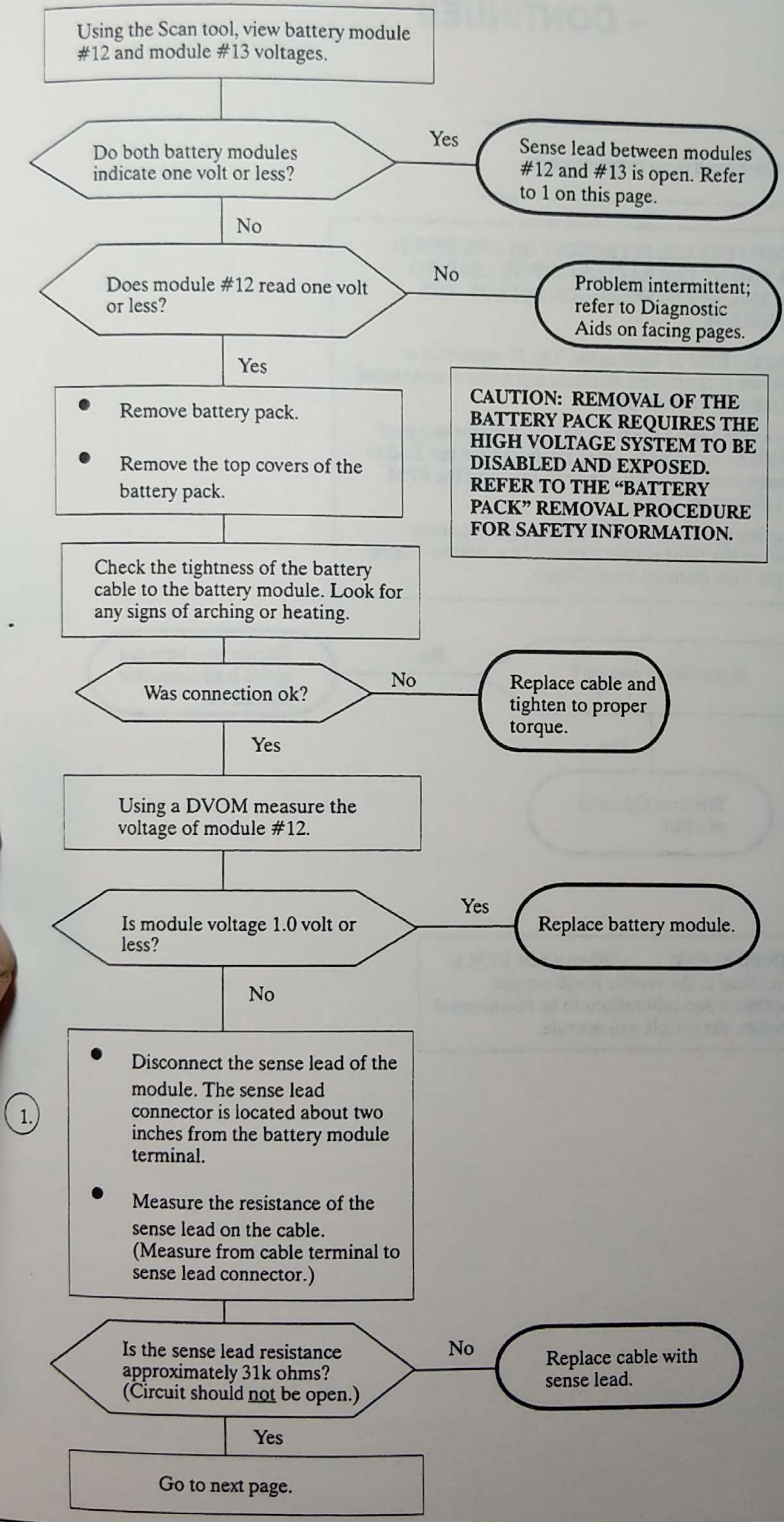
DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:
  1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
  2. Under "HIGH" discharge current (Heavy Load).
  3. When battery module state of charge (SOC) is "LOW."
- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 089
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #12)



Using the Scan tool, view battery module #12 and module #13 voltages.

Do both battery modules indicate one volt or less?

Yes: Sense lead between modules #12 and #13 is open. Refer to 1 on this page.

No: Does module #12 read one volt or less?

No: Problem intermittent; refer to Diagnostic Aids on facing pages.

Yes:

- Remove battery pack.
- Remove the top covers of the battery pack.

Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.

Was connection ok?

No: Replace cable and tighten to proper torque.

Yes: Using a DVOM measure the voltage of module #12.

Is module voltage 1.0 volt or less?

Yes: Replace battery module.

No:

1.

- Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
- Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)

Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)

No: Replace cable with sense lead.

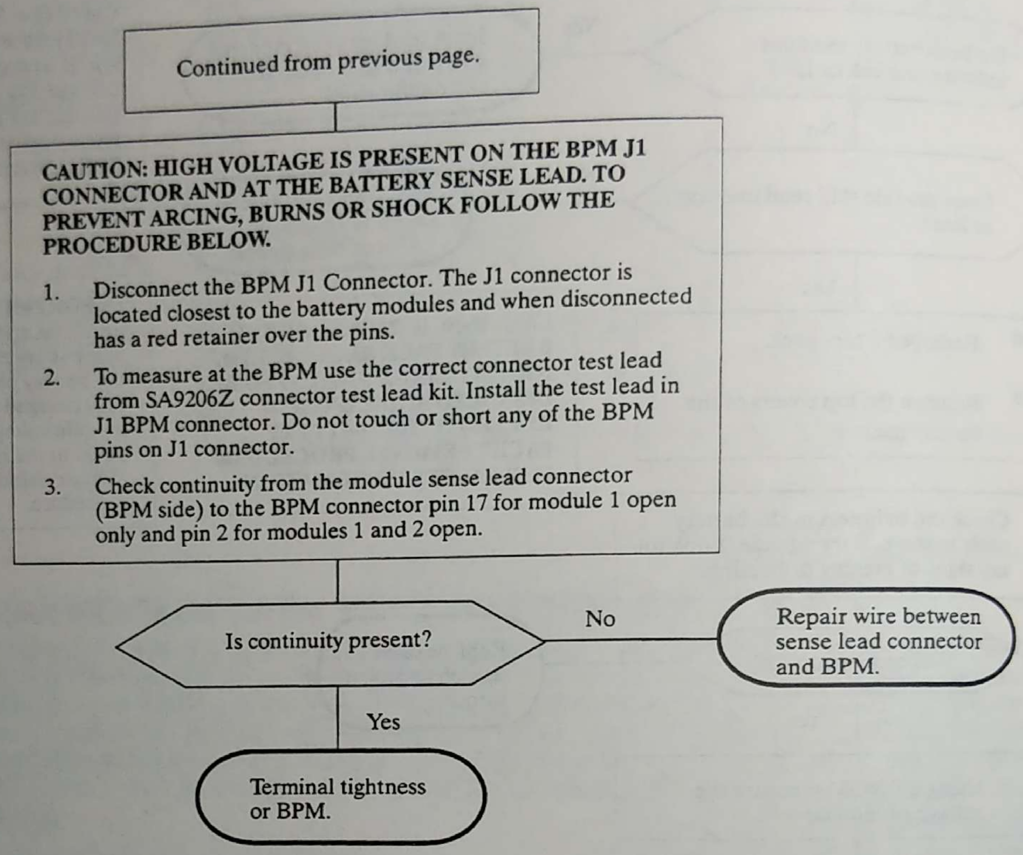
Yes: Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 089
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #12) – CONTINUED



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CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

Is continuity present?

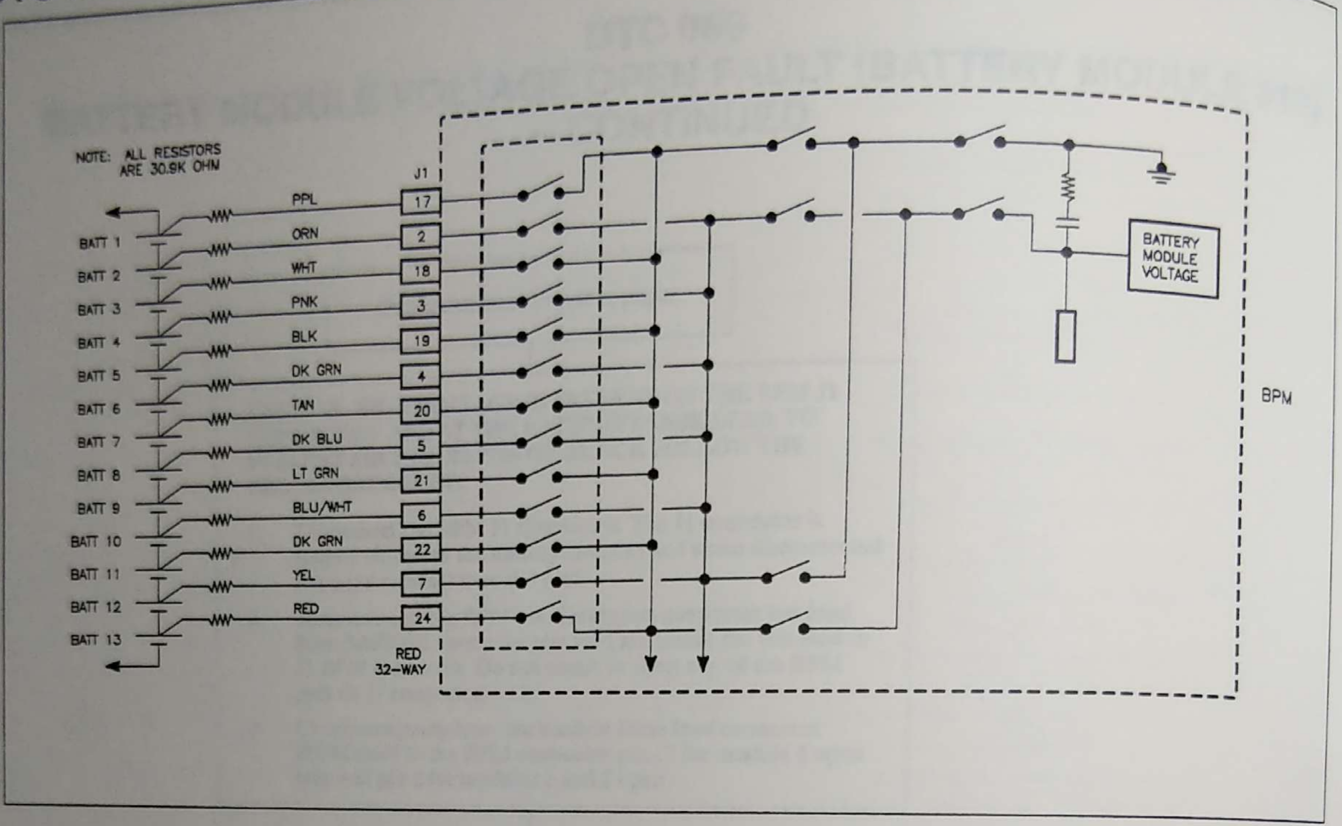
No: Repair wire between sense lead connector and BPM.

Yes: Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 091 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #12)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #12: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

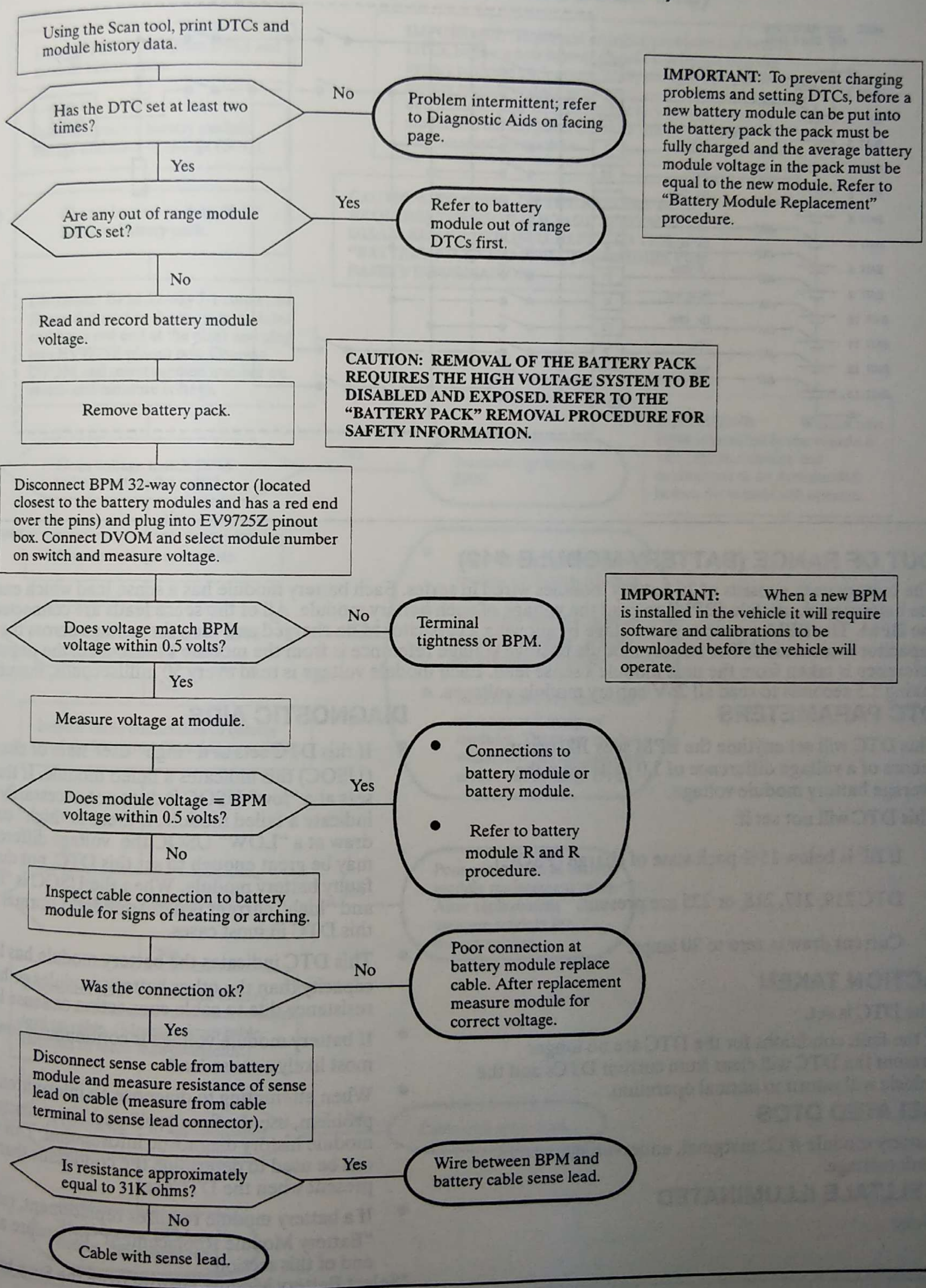
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

DTC 091
MARGINAL (BATTERY MODULE #12)



Using the Scan tool, print DTCs and module history data.

Has the DTC set at least two times?

No: Problem intermittent; refer to Diagnostic Aids on facing page.

Yes: Are any out of range module DTCs set?

Yes: Refer to battery module out of range DTCs first.

No: Read and record battery module voltage.

Remove battery pack.

Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

No: Terminal tightness or BPM.

Yes: Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

Yes:
- Connections to battery module or battery module.
- Refer to battery module R and R procedure.

No: Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

No: Poor connection at battery module replace cable. After replacement measure module for correct voltage.

Yes: Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).

Is resistance approximately equal to 31K ohms?

Yes: Wire between BPM and battery cable sense lead.

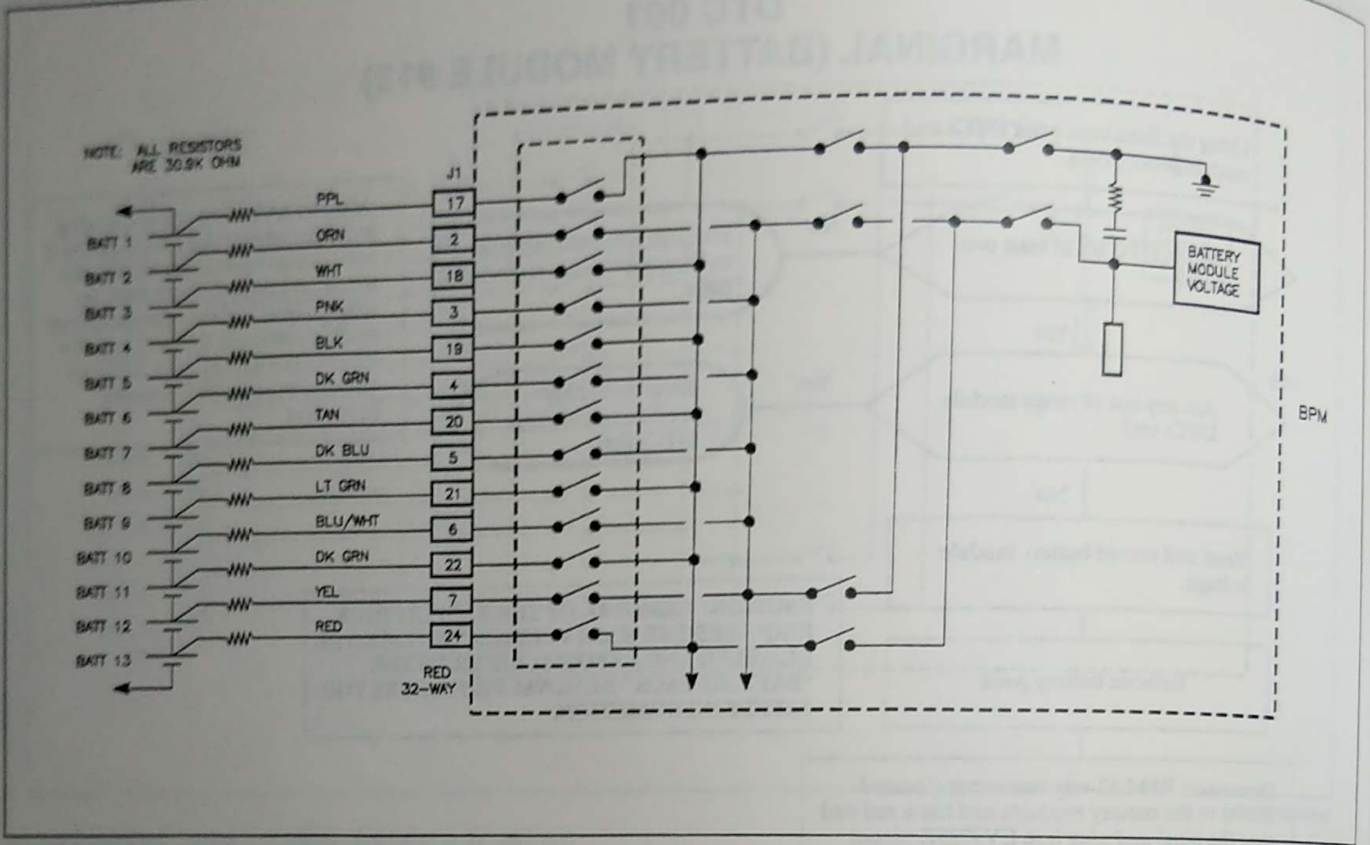
No: Cable with sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 092 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #12)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #12: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

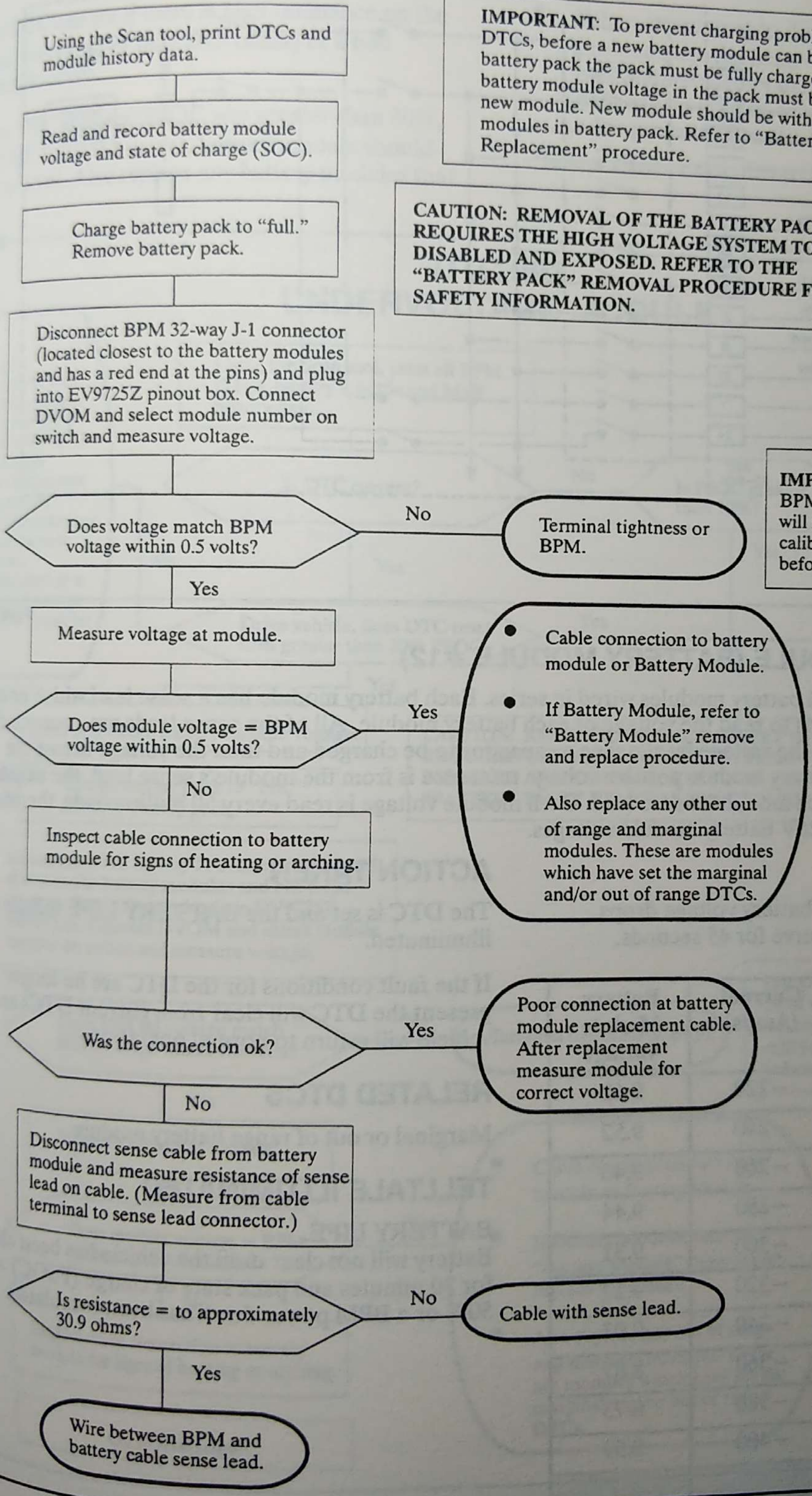
*Select Battery Module History from the Scan tool BPM menu.

DTC 092
OUT OF RANGE (BATTERY MODULE #12)

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.



Using the Scan tool, print DTCs and module history data.

Read and record battery module voltage and state of charge (SOC).

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

No: Terminal tightness or BPM.

Yes: Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

Yes:
- Cable connection to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

No: Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Yes: Poor connection at battery module replacement cable. After replacement measure module for correct voltage.

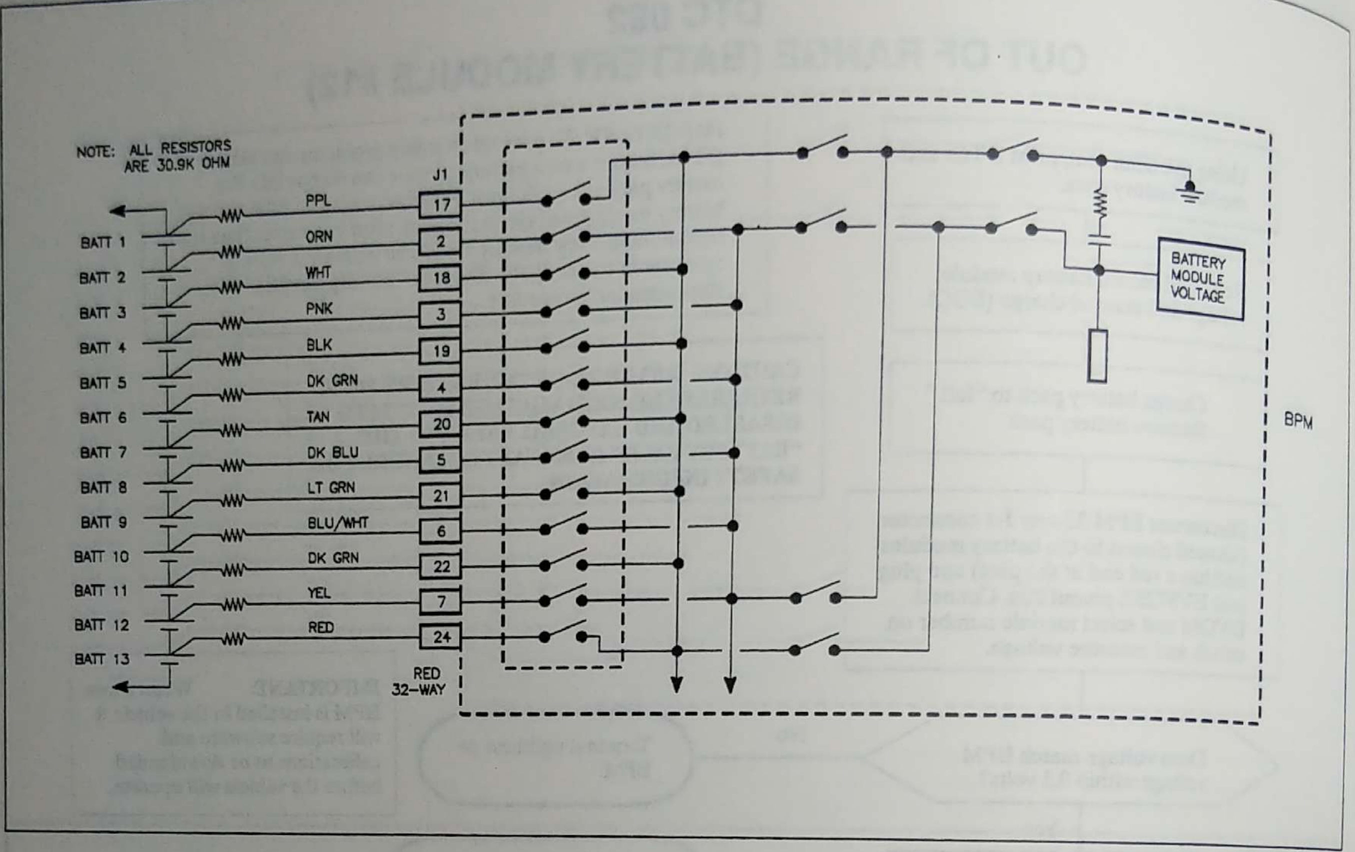
No: Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)

Is resistance = to approximately 30.9 ohms?

No: Cable with sense lead.

Yes: Wire between BPM and battery cable sense lead.

DTC 093 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #12)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage
0	11.75
−20	11.10
−40	10.90
−60	10.65
−80	10.45
−100	10.30
−120	10.15
−140	10.00
−160	9.90
−180	9.80
−200	9.70
−220	9.60
−240	9.52
−260	9.48
−280	9.44
−300	9.31
−320	9.17
−340	9.03
−360	8.87
−380	8.73
−400	8.59

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

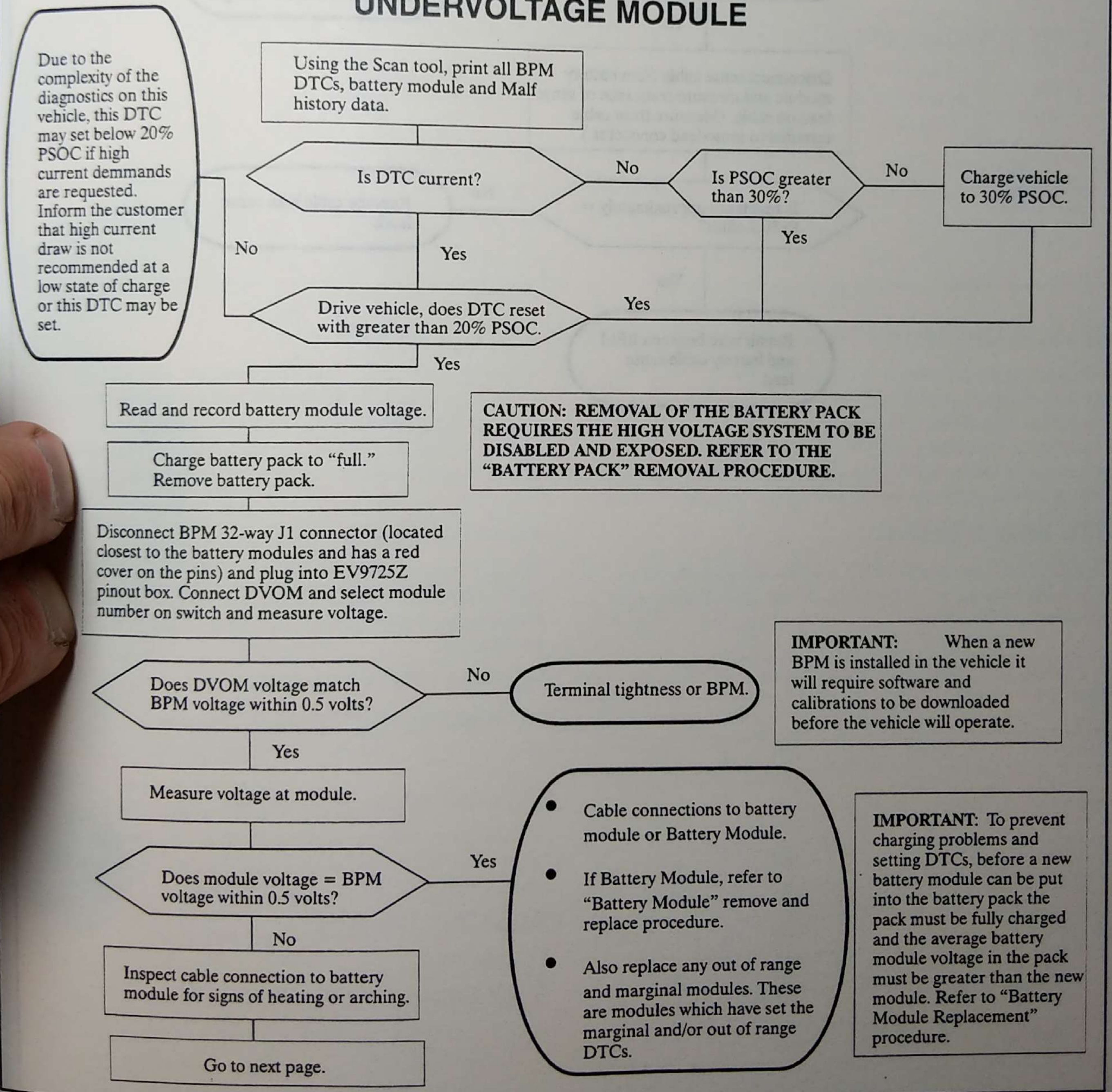
BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below 0% user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 093
UNDERVOLTAGE MODULE


Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
Cable connections to battery module or Battery Module.
If Battery Module, refer to "Battery Module" remove and replace procedure.
Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

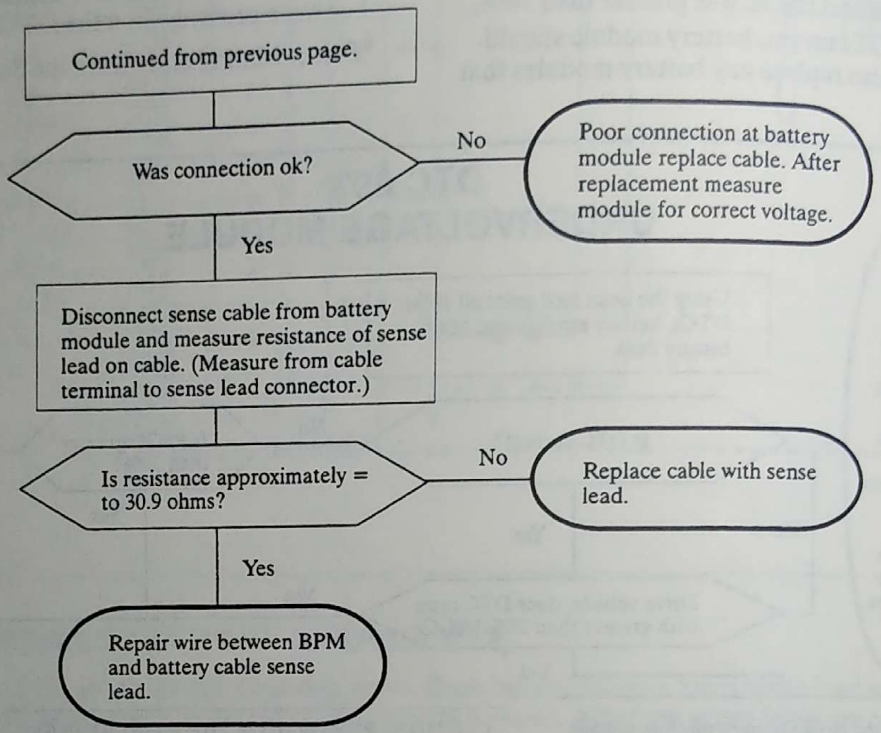
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

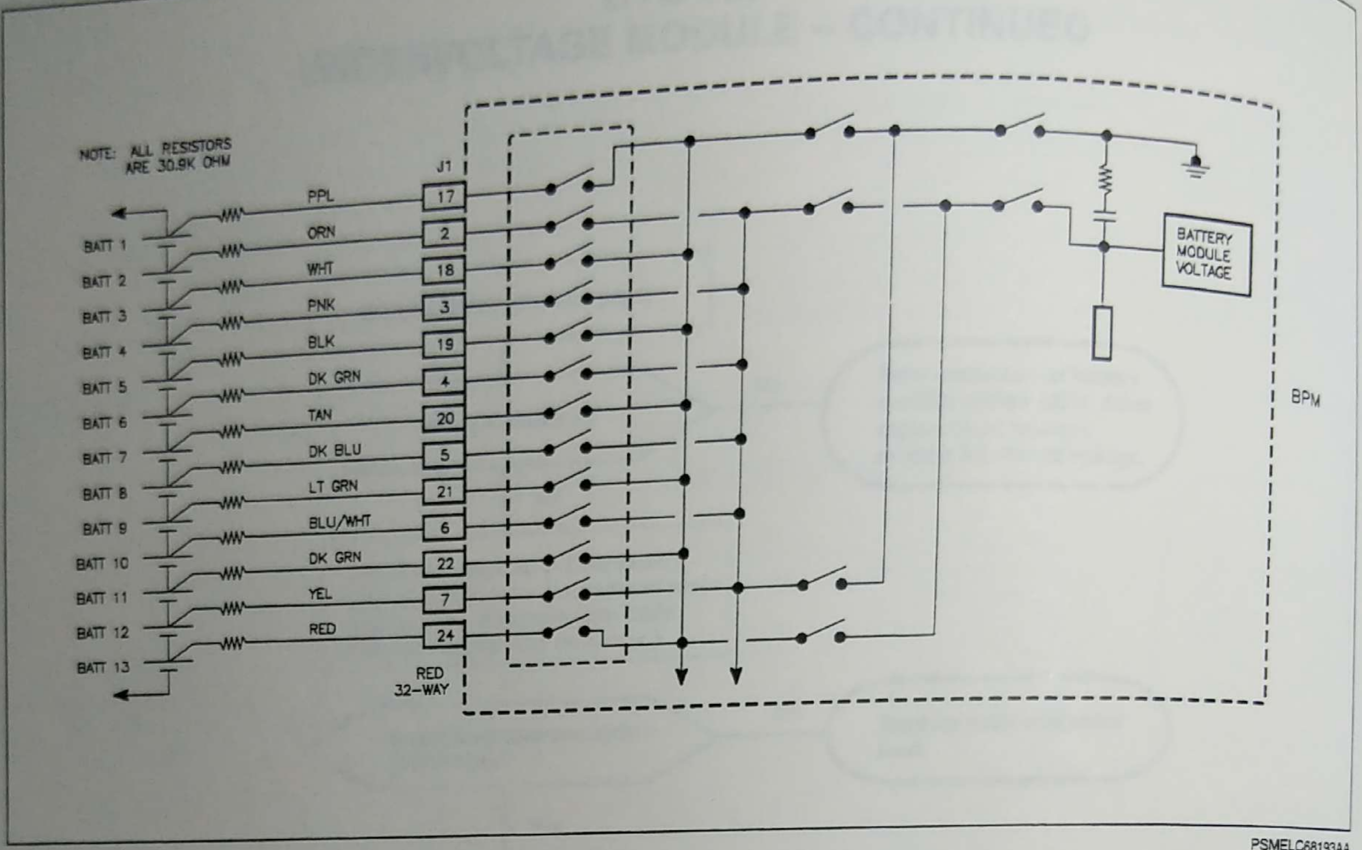
DTC 093

UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 094 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #12)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage
0	11.45
-20	10.55
-40	10.20
-60	9.95
-80	9.75
-100	9.60
-120	9.45
-140	9.30
-160	9.20
-180	9.10
-200	9.00
-220	8.90
-240	8.82
-260	8.78
-280	8.74
-300	8.70
-320	8.66
-340	8.58
-360	8.43
-380	8.28
-400	8.14

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

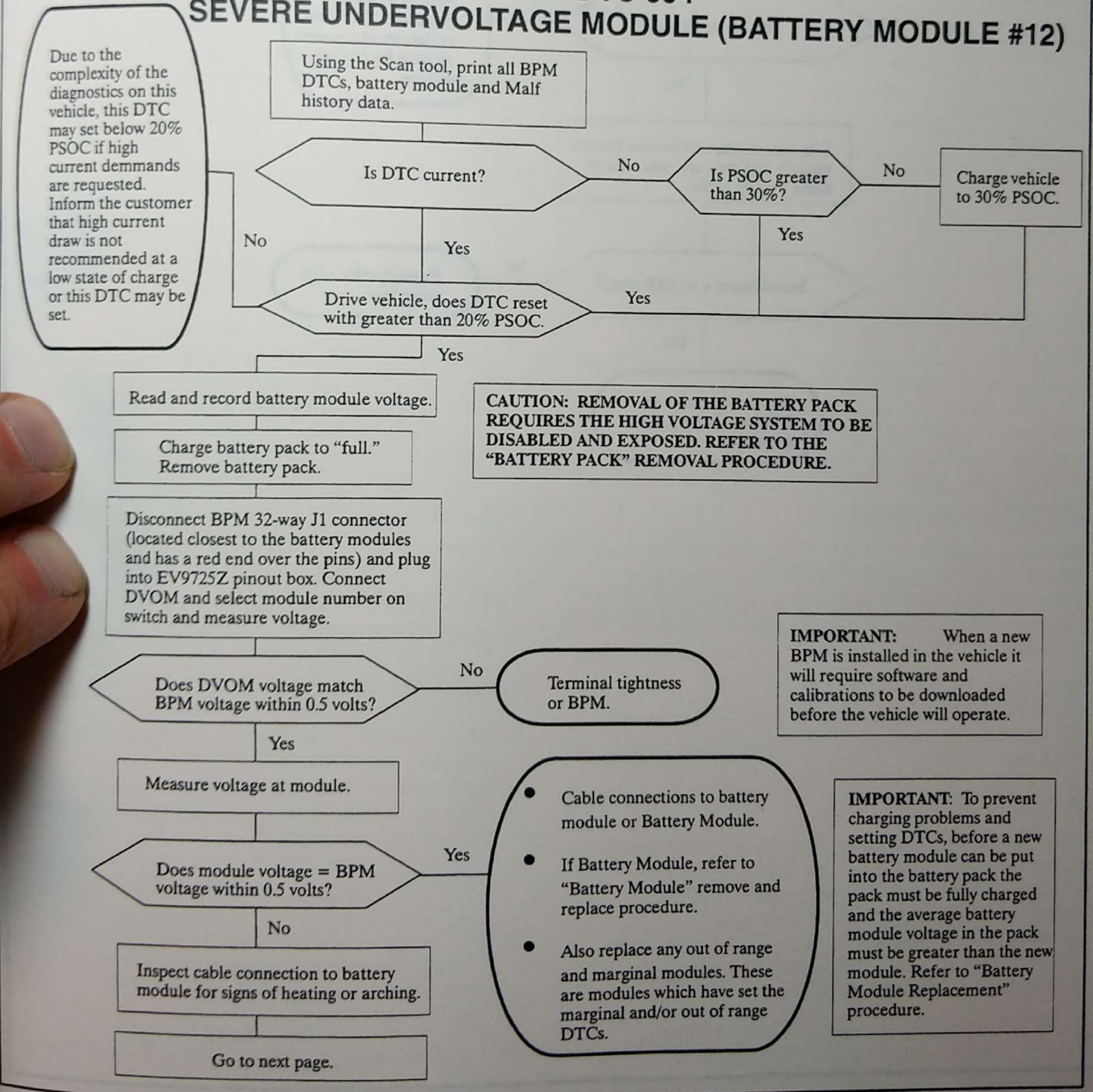
Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches 0% user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 094
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #12)



Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

Using the Scan tool, print all BPM DTCs, battery module and Malf history data.

Is DTC current?

Is PSOC greater than 30%?

Charge vehicle to 30% PSOC.

Drive vehicle, does DTC reset with greater than 20% PSOC.

Read and record battery module voltage.

Charge battery pack to "full." Remove battery pack.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

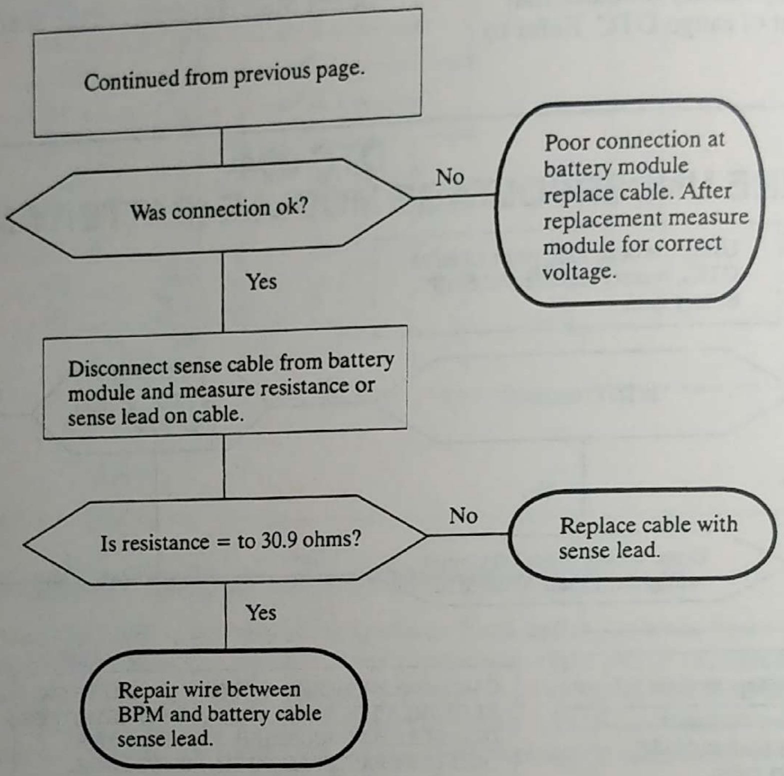
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

Inspect cable connection to battery module for signs of heating or arching.

Go to next page.

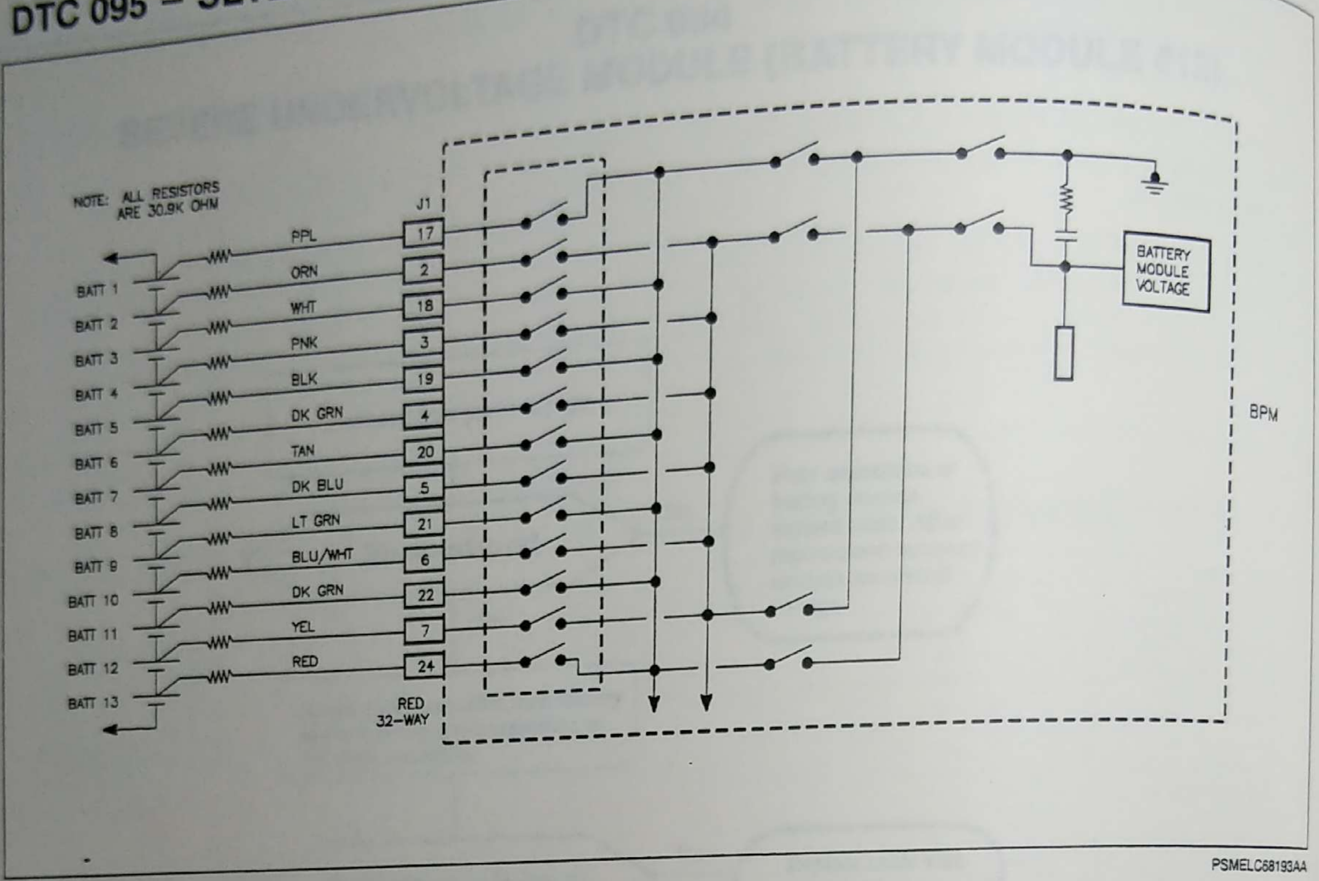
CS CamScanner

DTC 094
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #12)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 095 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #12)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

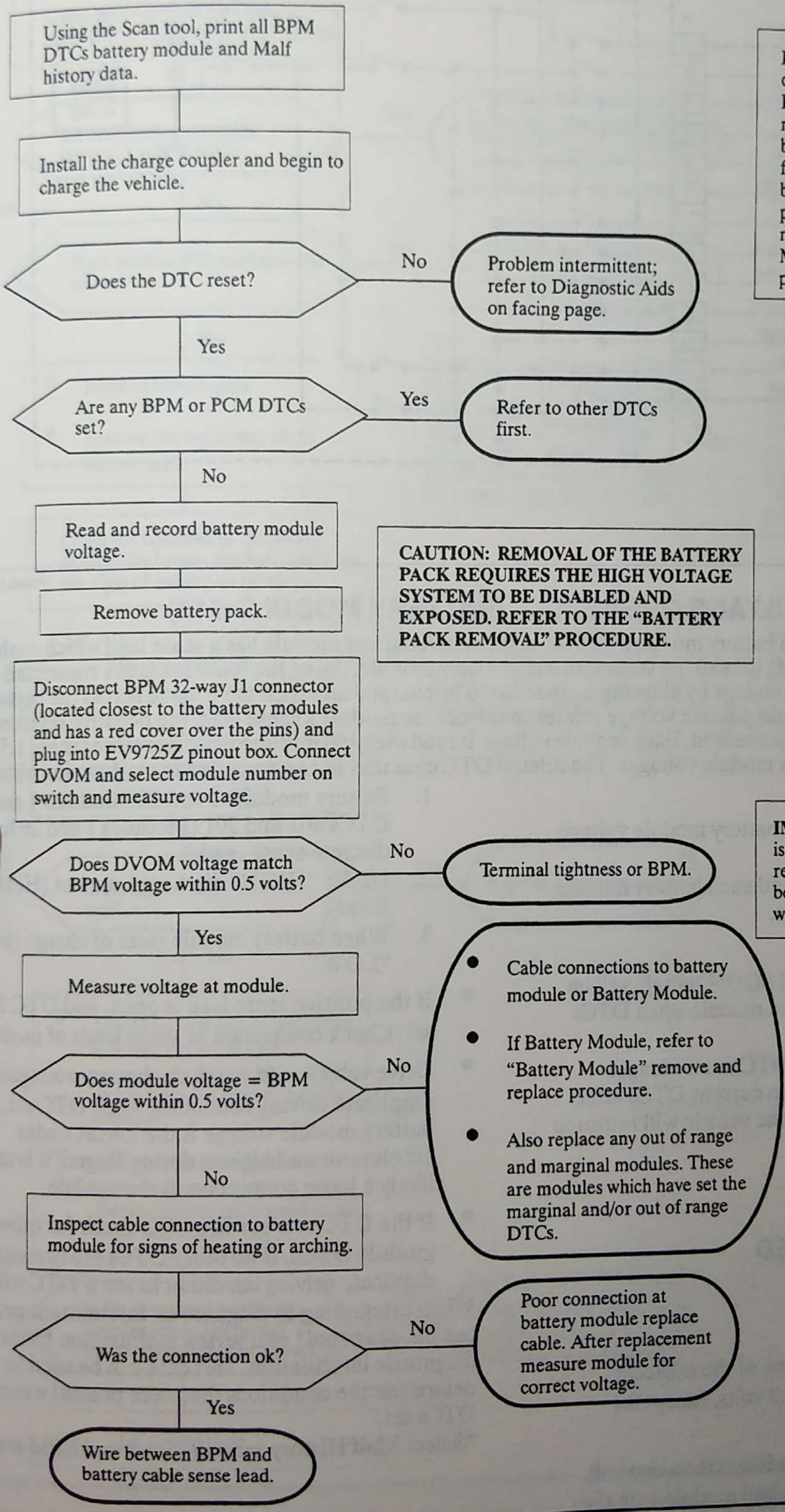
SERVICE NOW and REDUCED PERFORMANCE

DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

DTC 095
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #12)

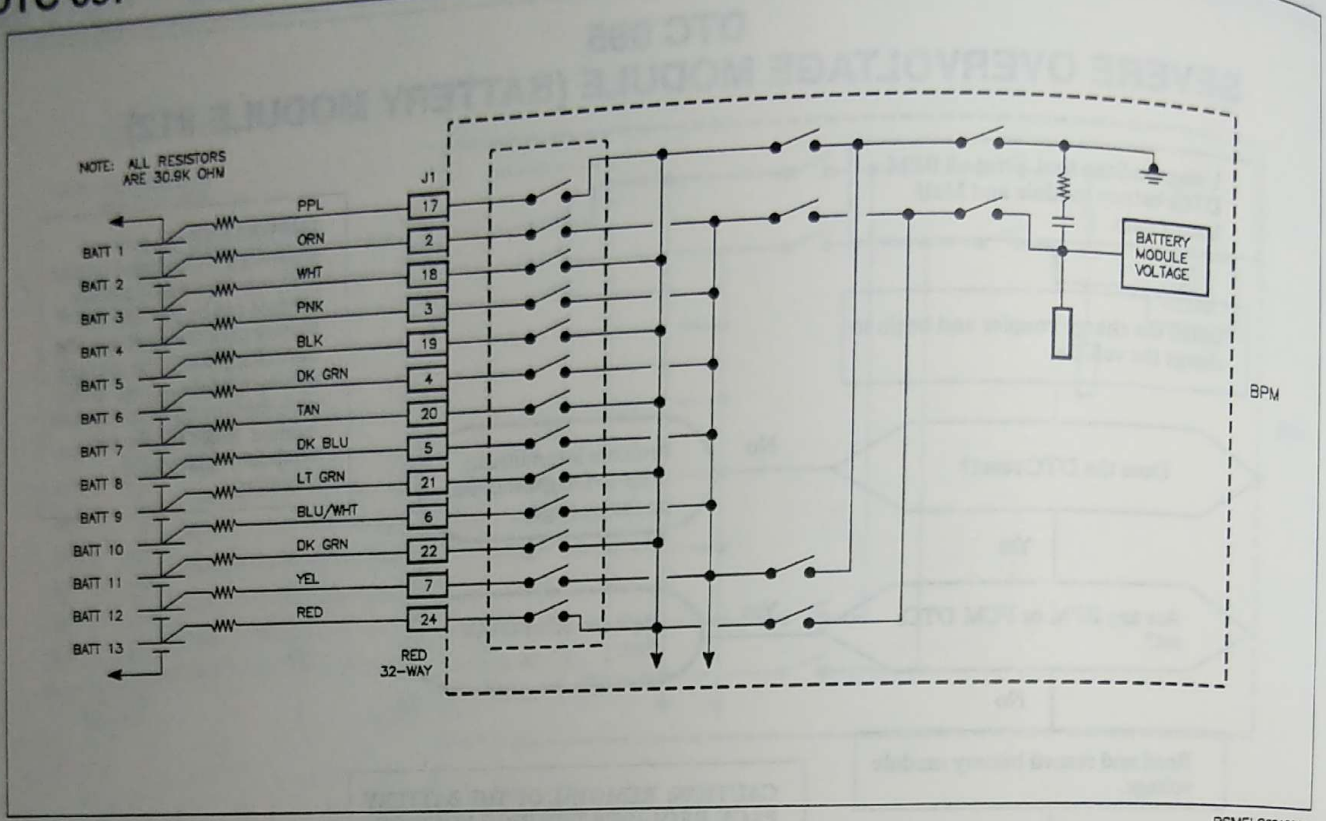

Using the Scan tool, print all BPM DTCs battery module and Malf history data.
Install the charge coupler and begin to charge the vehicle.
Does the DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any BPM or PCM DTCs set?
Yes
Refer to other DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
No
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 097 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #13)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:

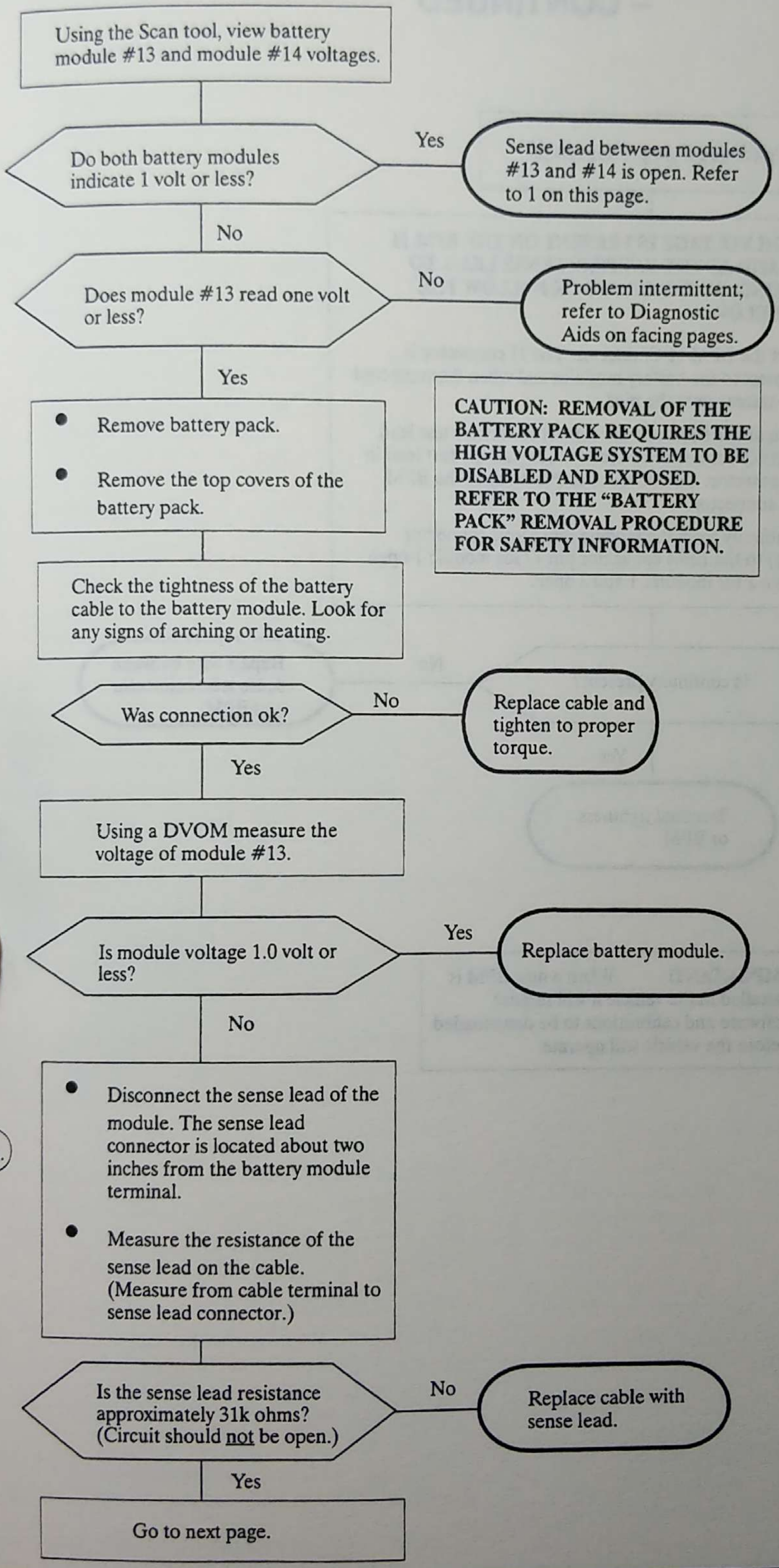
  1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
  2. Under "HIGH" discharge current (Heavy Load).
  3. When battery module state of charge (SOC) is "LOW."

- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 097
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #13)


Using the Scan tool, view battery module #13 and module #14 voltages.
Do both battery modules indicate 1 volt or less?
Yes
Sense lead between modules #13 and #14 is open. Refer to 1 on this page.
No
Does module #13 read one volt or less?
No
Problem intermittent; refer to Diagnostic Aids on facing pages.
Yes
Remove battery pack.
Remove the top covers of the battery pack.
Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.
Was connection ok?
No
Replace cable and tighten to proper torque.
Yes
Using a DVOM measure the voltage of module #13.
Is module voltage 1.0 volt or less?
Yes
Replace battery module.
No
1.
Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)
Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)
No
Replace cable with sense lead.
Yes
Go to next page.

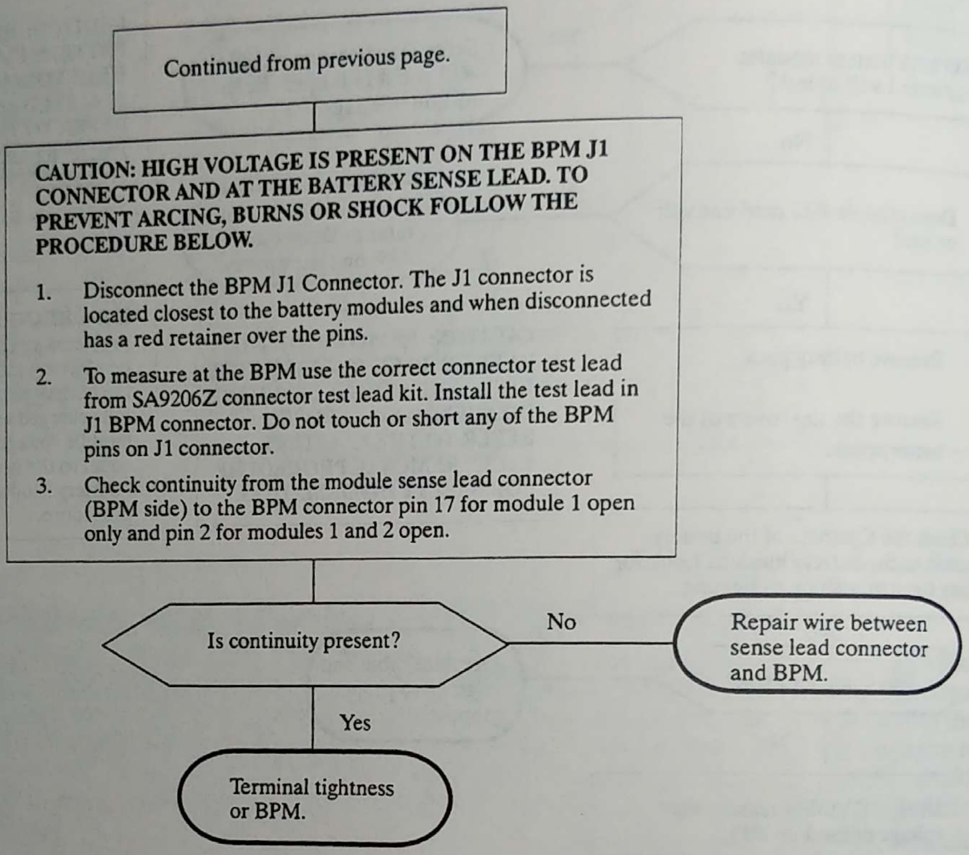
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 097

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #13) – CONTINUED



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CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

Is continuity present?

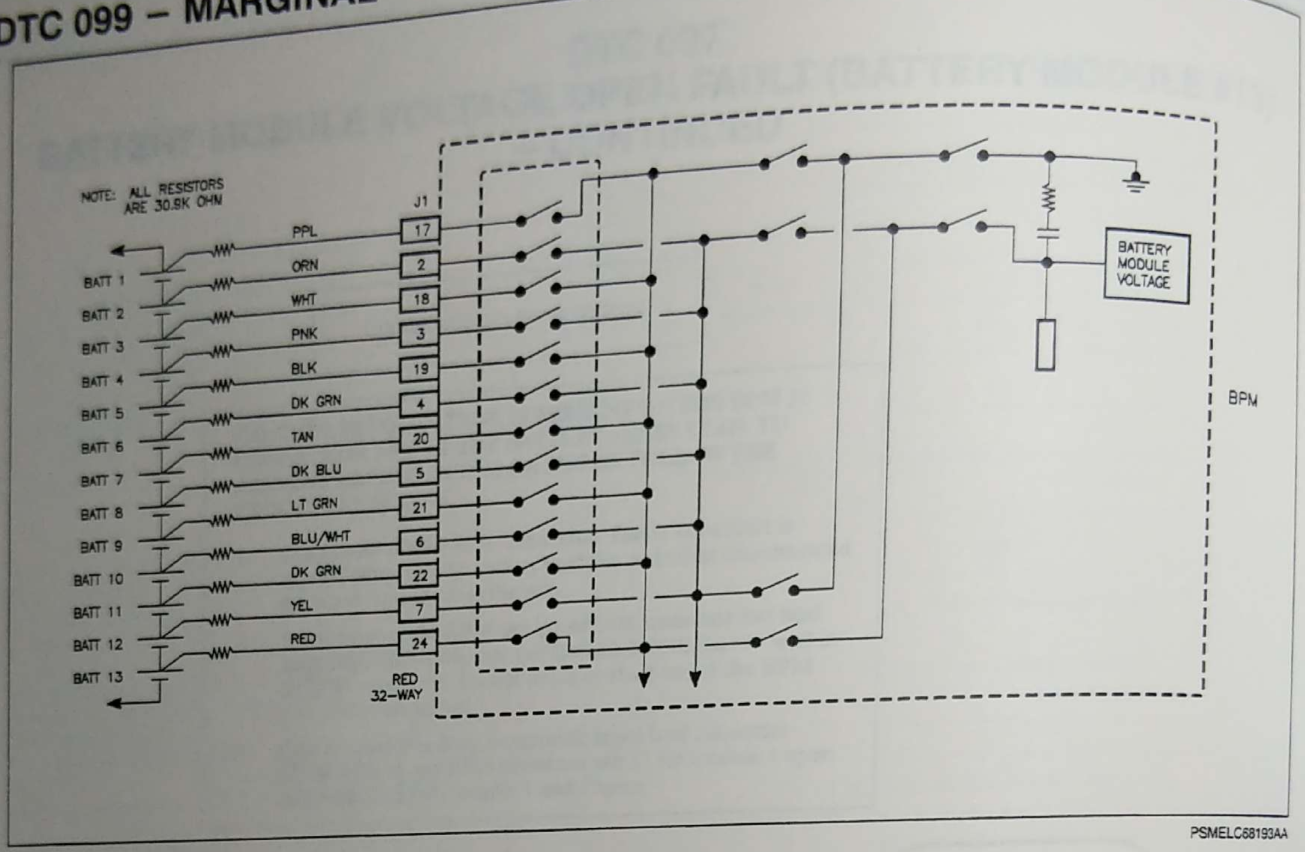
Repair wire between sense lead connector and BPM.

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 099 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #13)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #13: undervoltage, severe undervoltage our of range.

TELLTALE ILLUMINATED

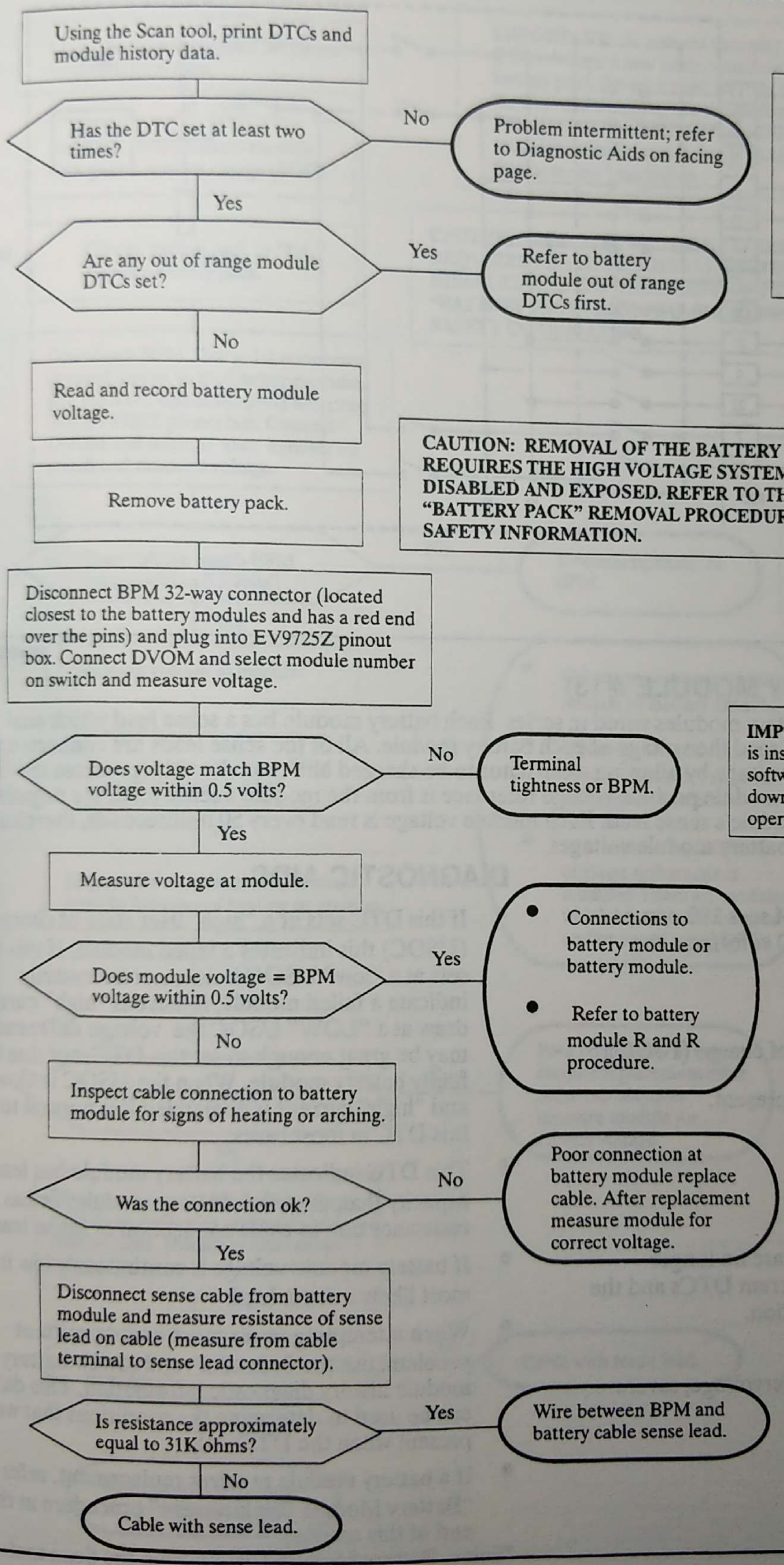
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

DTC 099
MARGINAL (BATTERY MODULE #13)

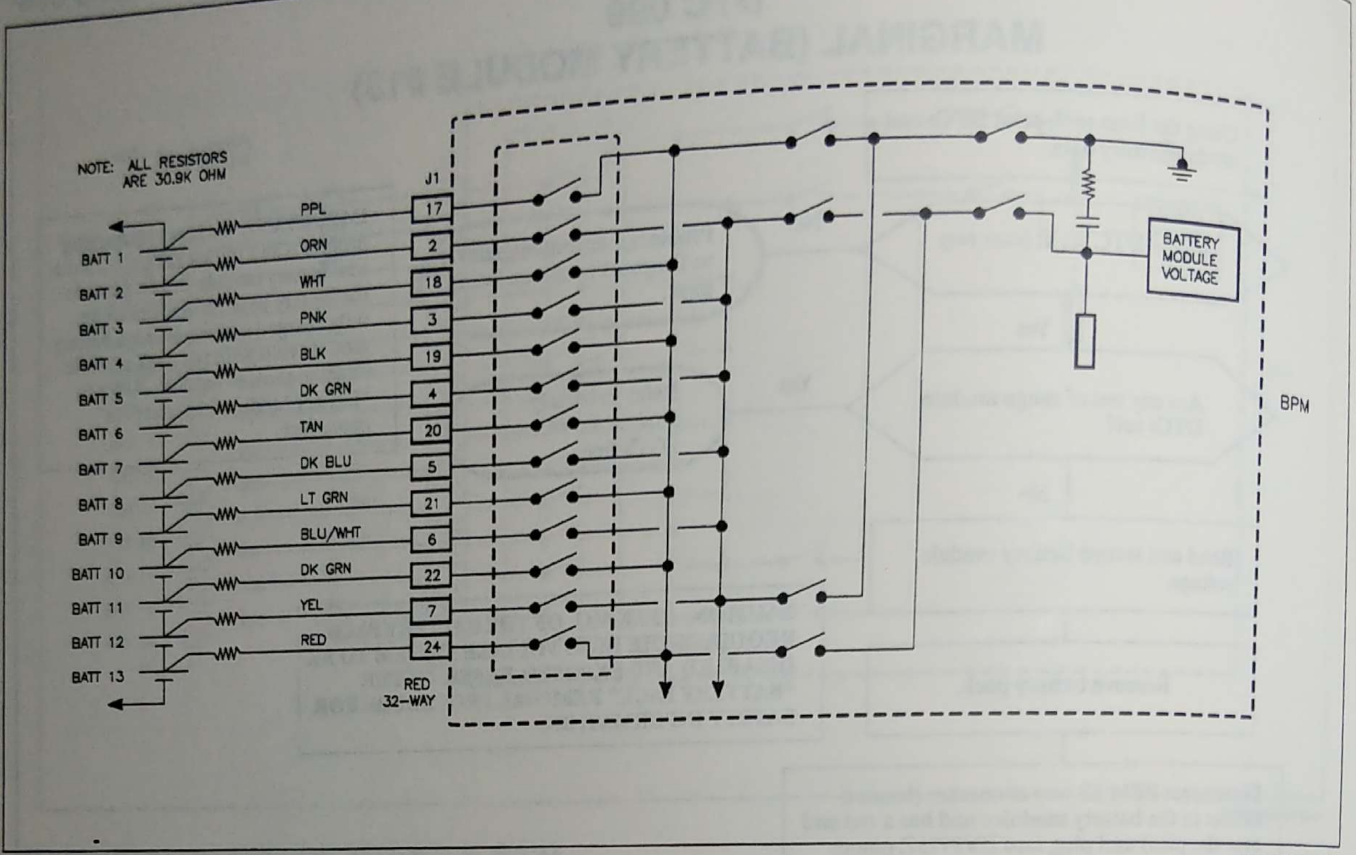

Using the Scan tool, print DTCs and module history data.
Has the DTC set at least two times?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any out of range module DTCs set?
Yes
Refer to battery module out of range DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Connections to battery module or battery module.
• Refer to battery module R and R procedure.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).
Is resistance approximately equal to 31K ohms?
Yes
Wire between BPM and battery cable sense lead.
No
Cable with sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 100 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #13)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is 0 to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #13: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

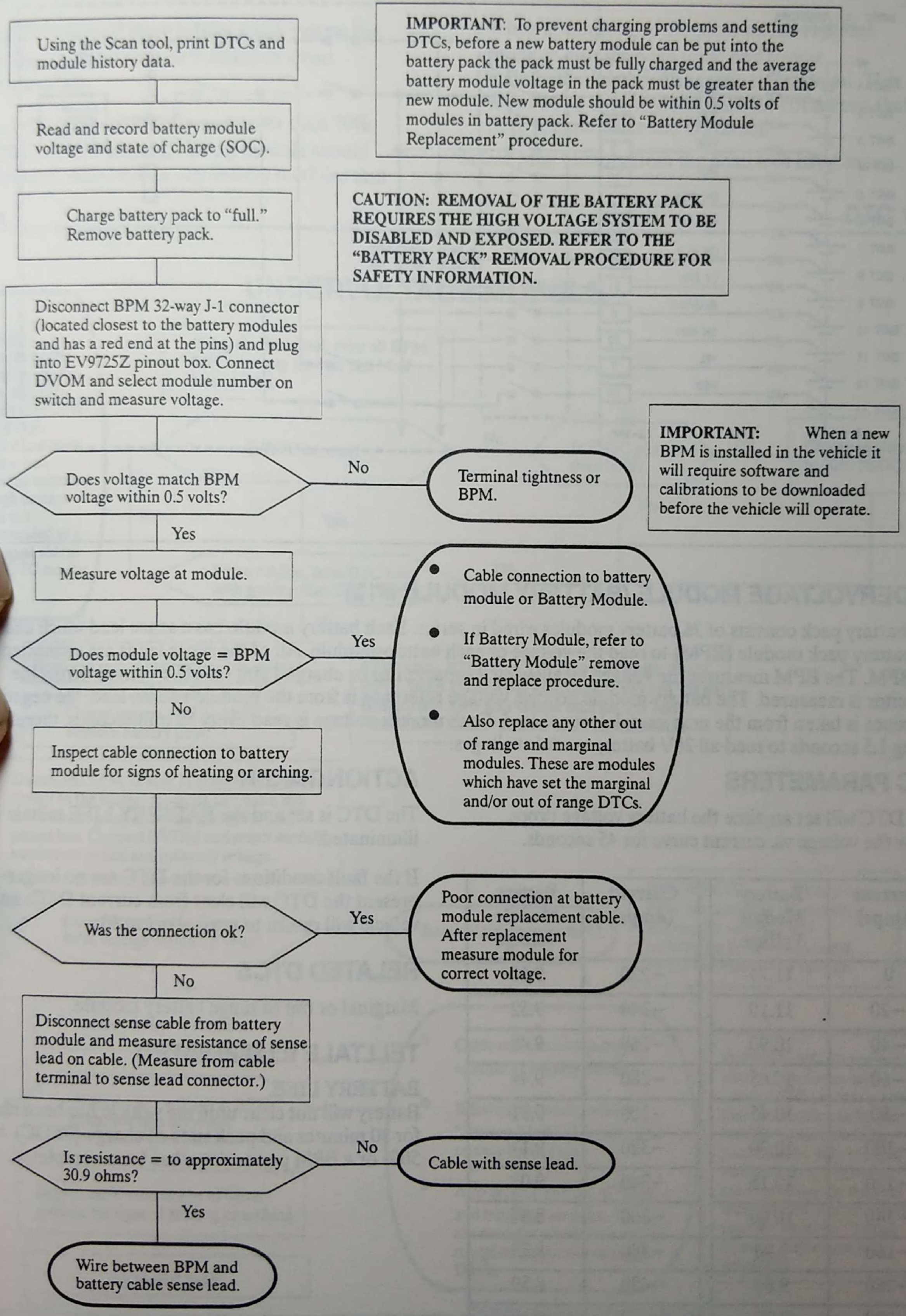
None

DIAGNOSTIC AIDS

- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

*Select Battery Module History from the Scan tool BPM menu.

DTC 100
OUT OF RANGE (BATTERY MODULE #13)

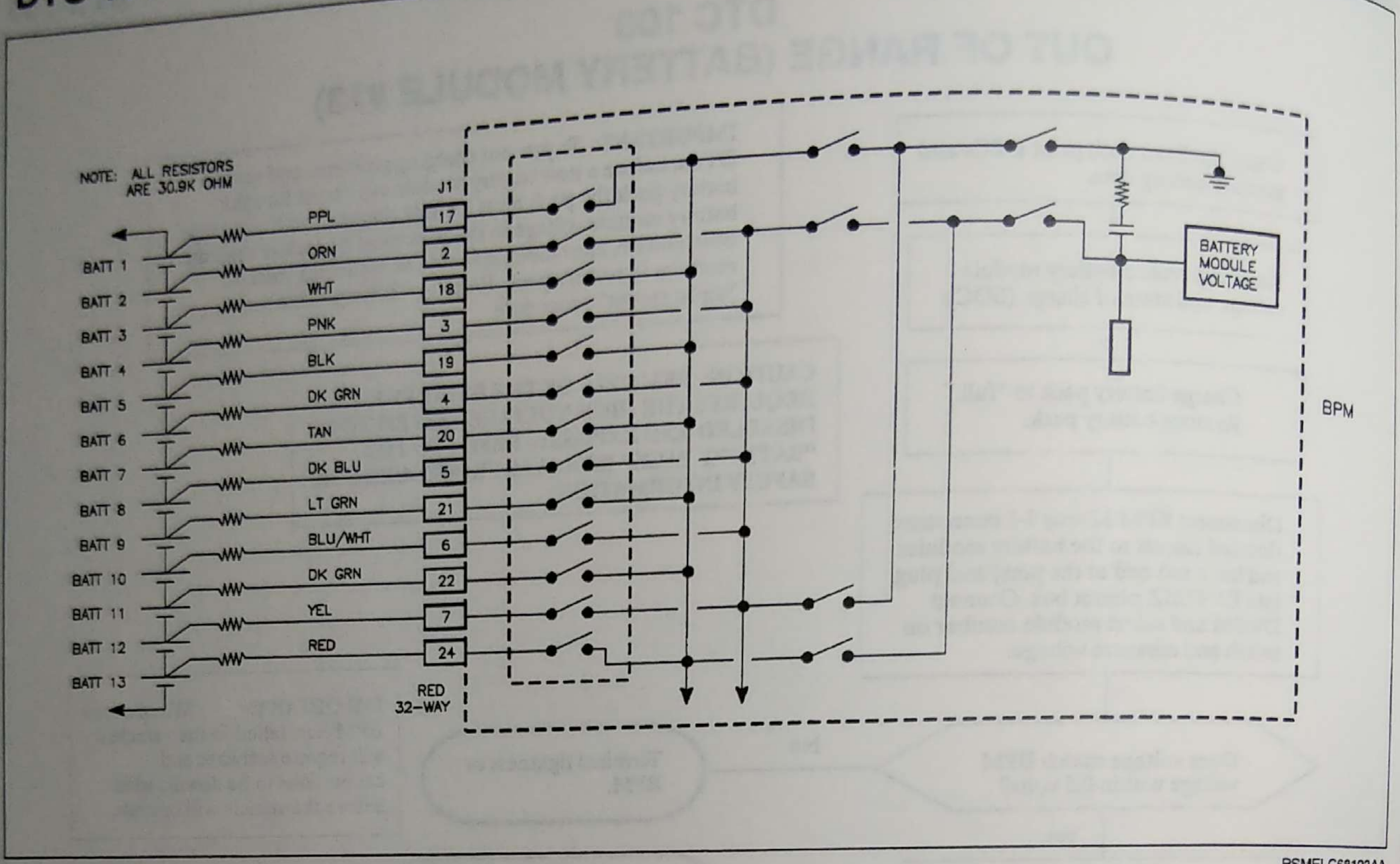

Using the Scan tool, print DTCs and module history data.
Read and record battery module voltage and state of charge (SOC).
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
Cable connection to battery module or Battery Module.
If Battery Module, refer to "Battery Module" remove and replace procedure.
Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
Yes
Poor connection at battery module replacement cable. After replacement measure module for correct voltage.
No
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance = to approximately 30.9 ohms?
No
Cable with sense lead.
Yes
Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 101 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #13)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage	Current (Amps)	Battery Module Voltage
0	11.75	−220	9.60
−20	11.10	−240	9.52
−40	10.90	−260	9.48
−60	10.65	−280	9.44
−80	10.45	−300	9.31
−100	10.30	−320	9.17
−120	10.15	−340	9.03
−140	10.00	−360	8.87
−160	9.90	−380	8.73
−180	9.80	−400	8.59
−200	9.70		

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

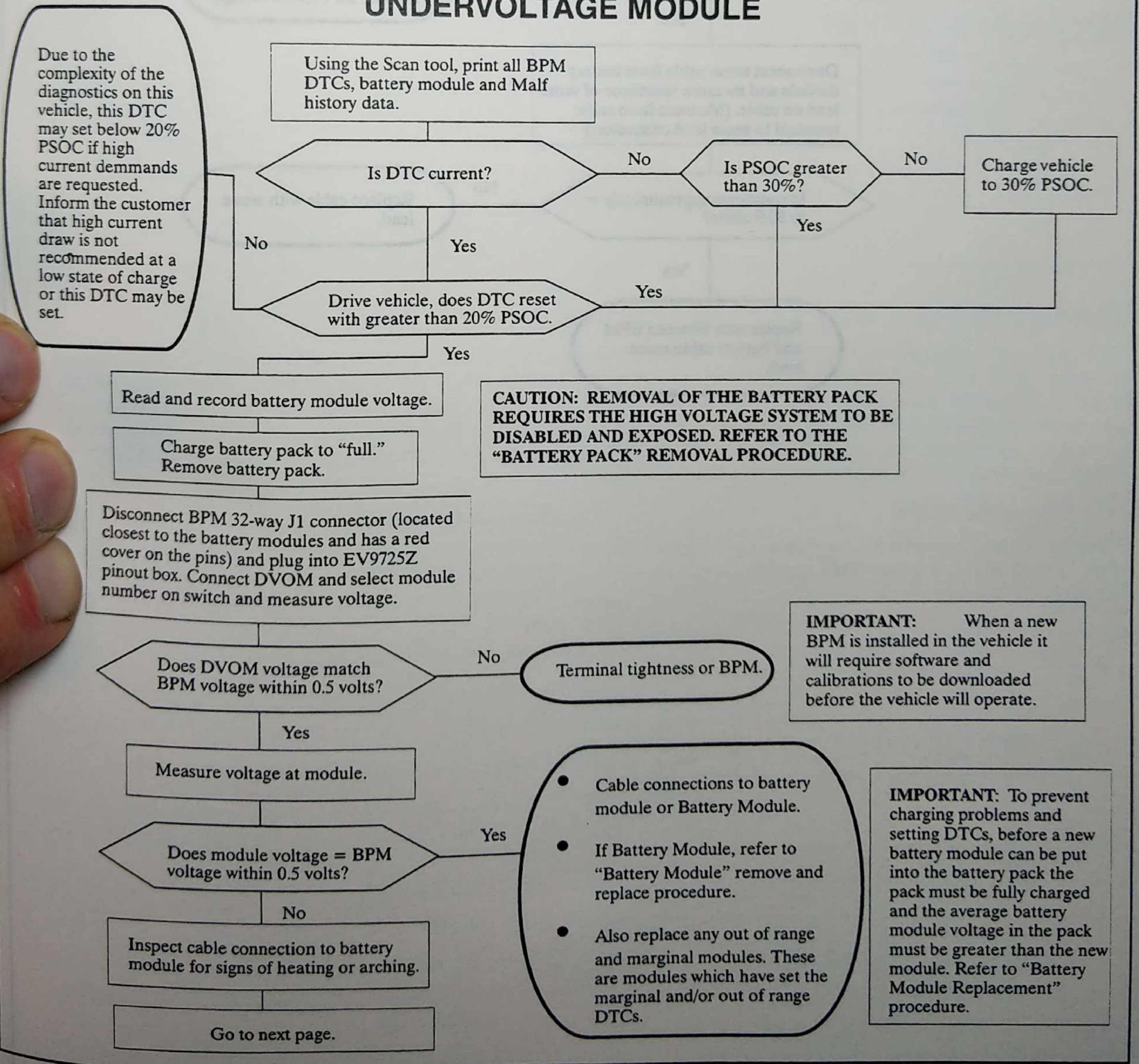
BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below zero percent user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 101
UNDERVOLTAGE MODULE

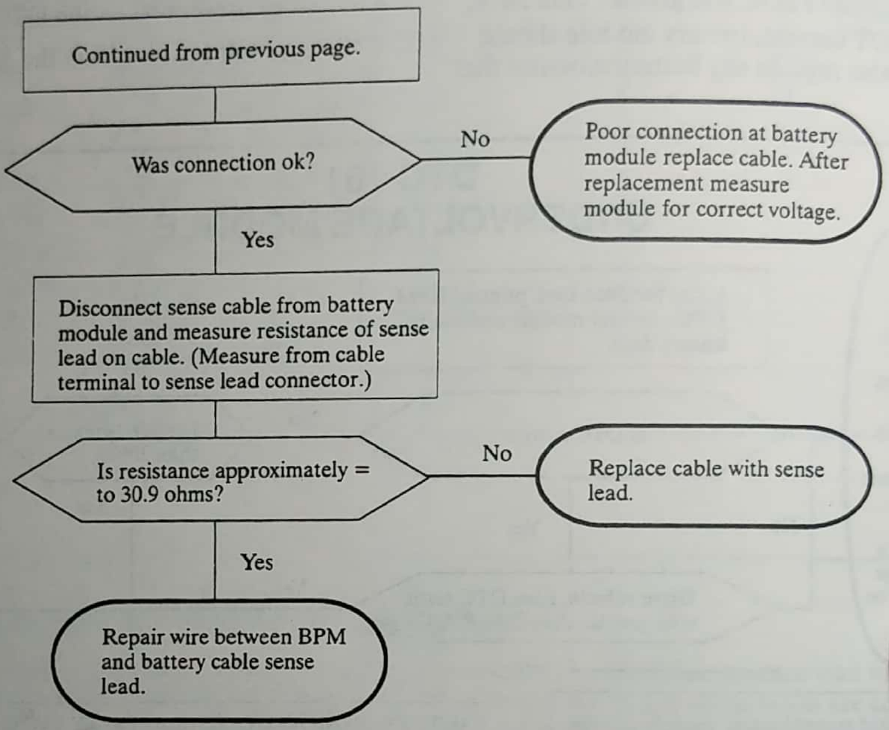

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
Cable connections to battery module or Battery Module.
If Battery Module, refer to "Battery Module" remove and replace procedure.
Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

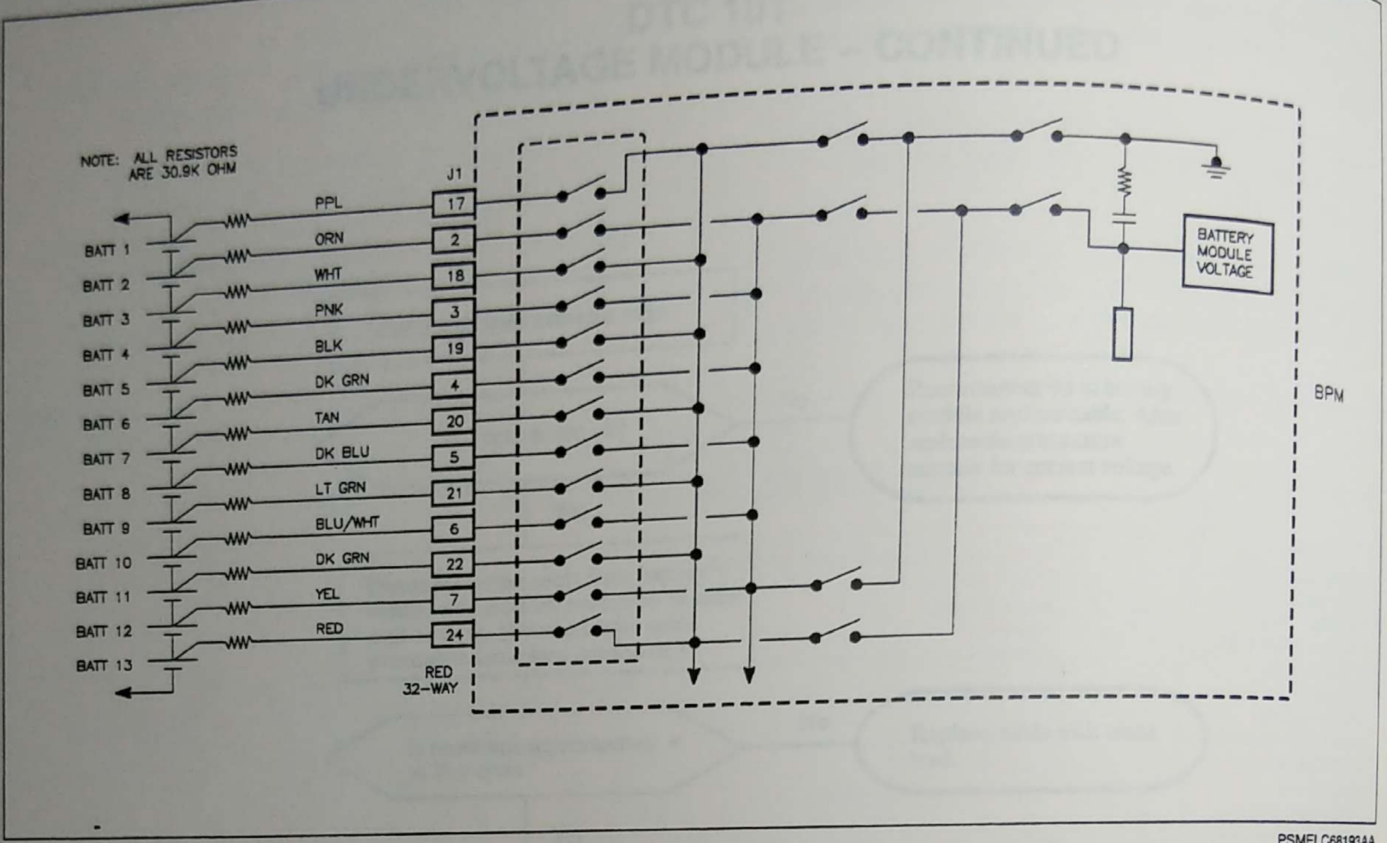
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 101
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 102 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
J1
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #13)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

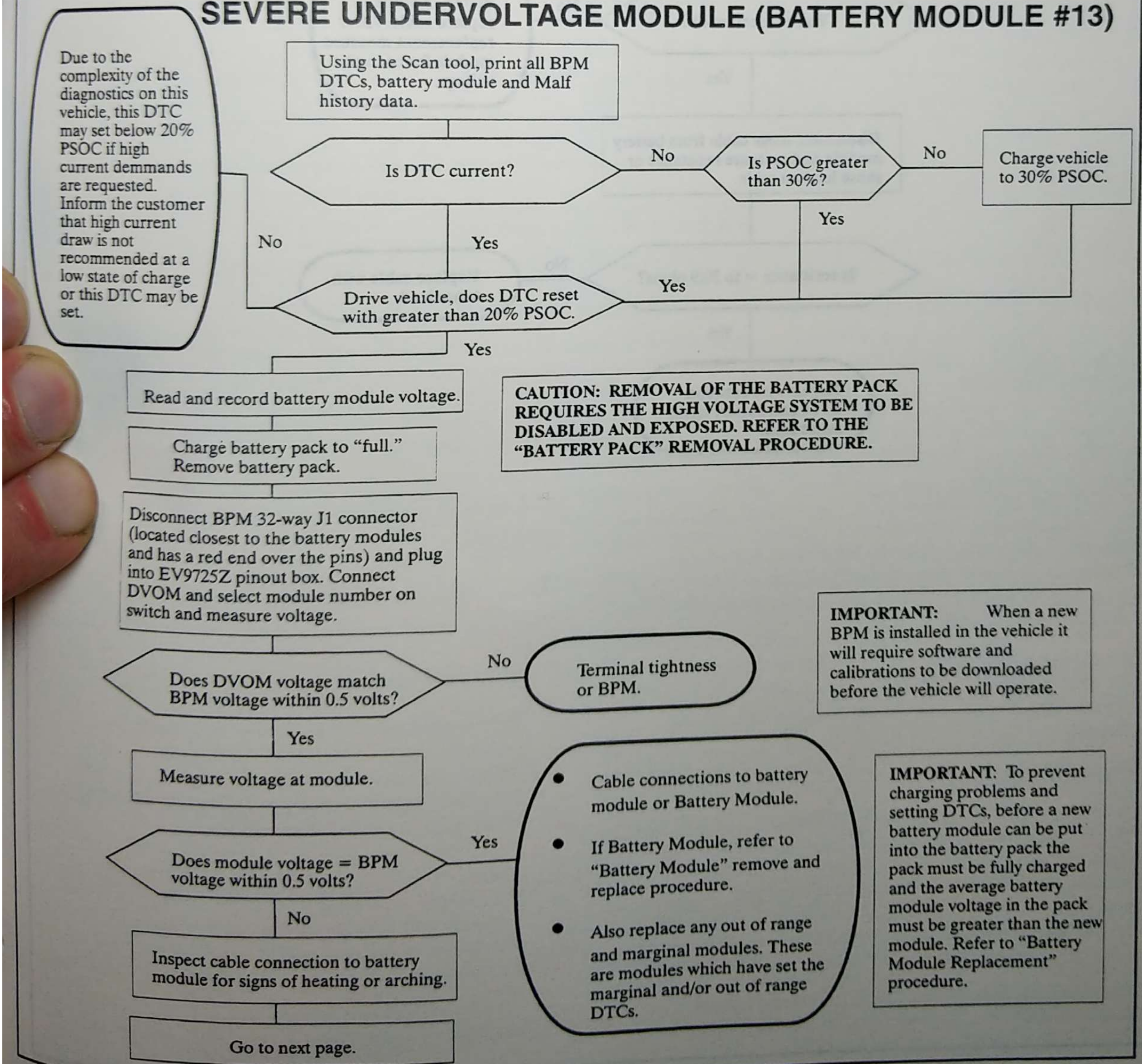
Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches zero percent user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 102
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #13)



Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

Using the Scan tool, print all BPM DTCs, battery module and Malf history data.

Is DTC current?

Is PSOC greater than 30%?

Charge vehicle to 30% PSOC.

Drive vehicle, does DTC reset with greater than 20% PSOC.

Read and record battery module voltage.

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

Inspect cable connection to battery module for signs of heating or arching.

Go to next page.

- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

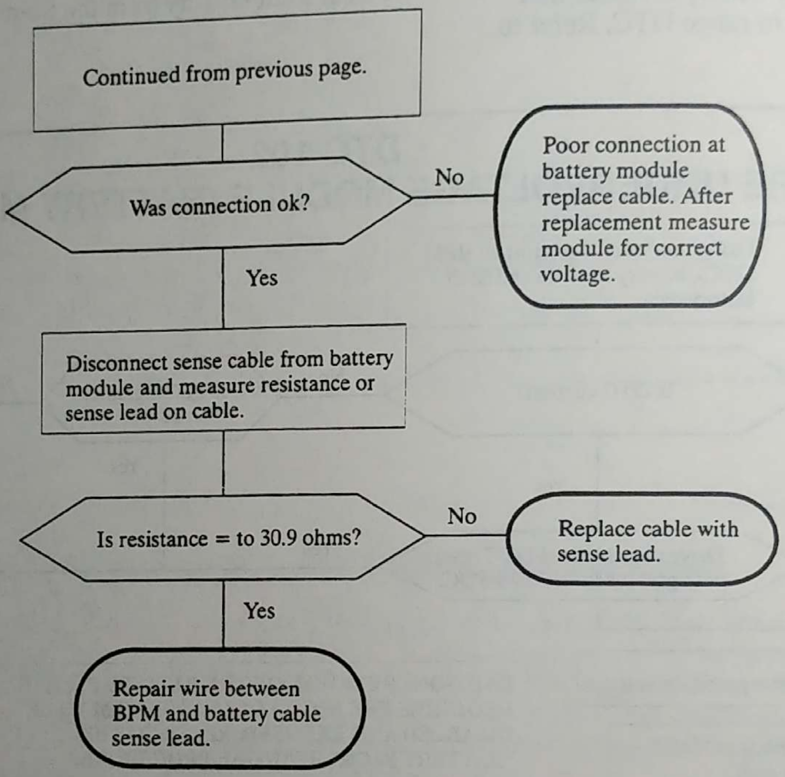
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

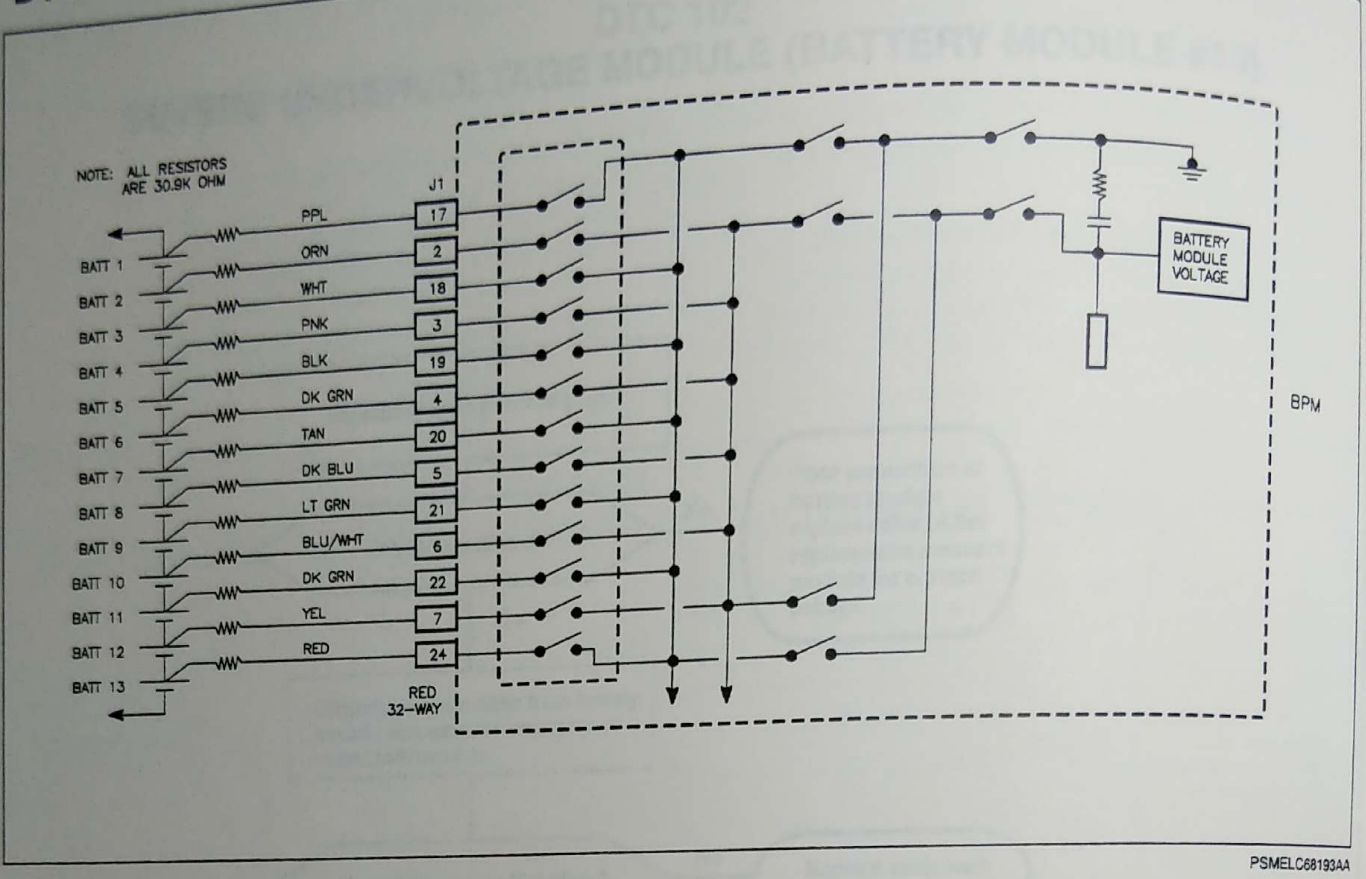
DTC 102

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #13)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 103 – SEVERE OVERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32–WAY
BATTERY MODULE VOLTAGE
BPM
PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #13)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

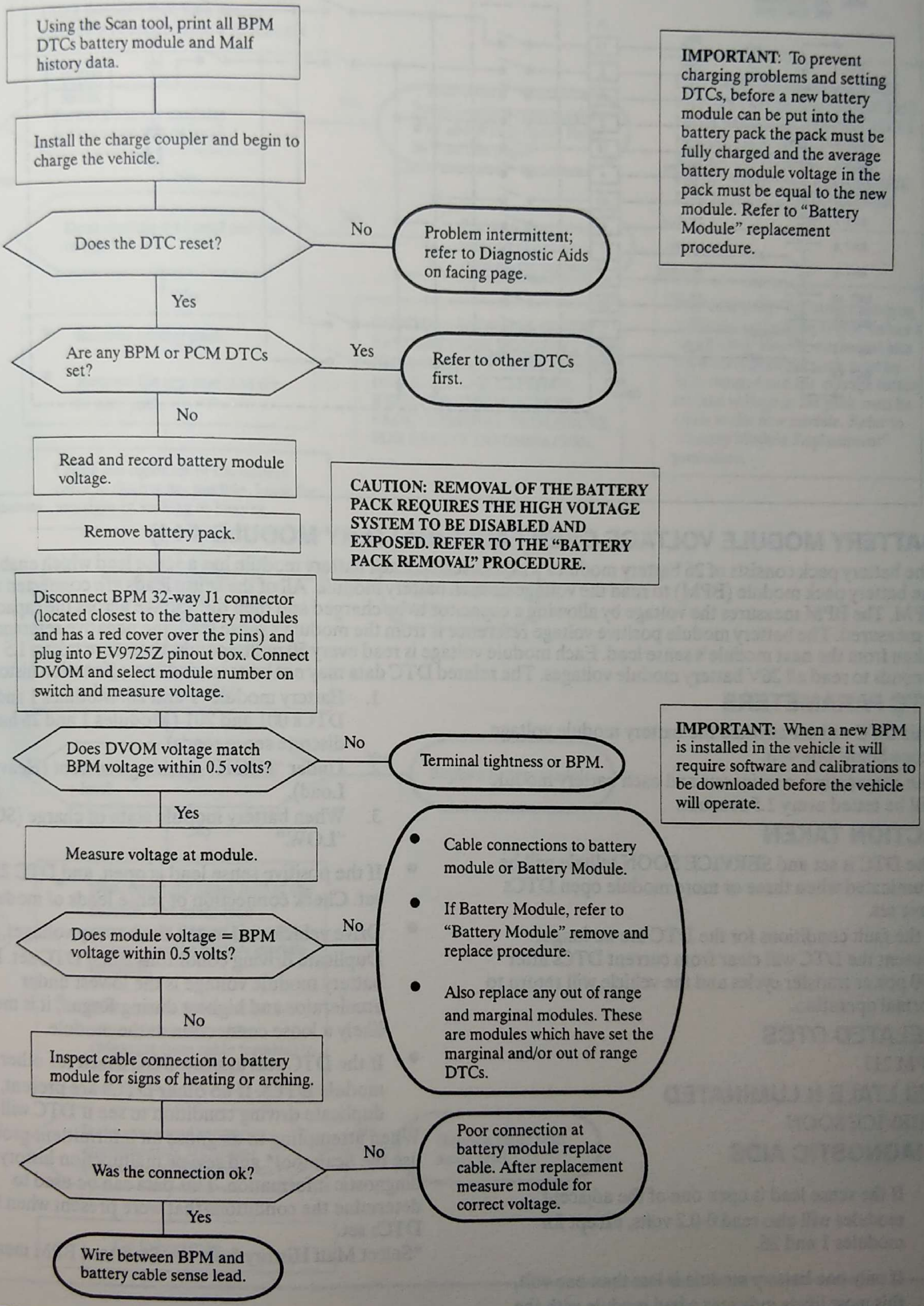
SERVICE NOW and REDUCED PERFORMANCE

DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

DTC 103
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #13)

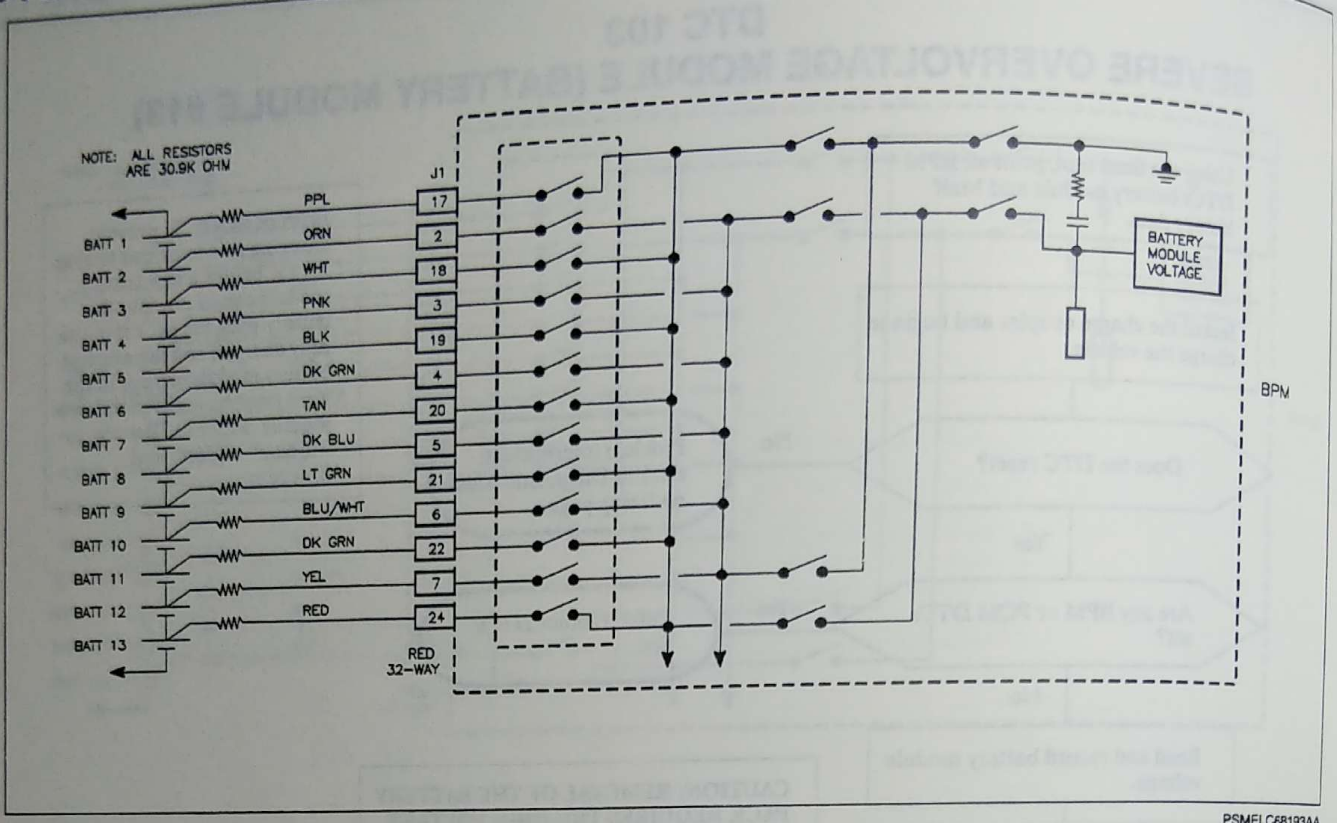

Using the Scan tool, print all BPM DTCs battery module and Malf history data.
Install the charge coupler and begin to charge the vehicle.
Does the DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any BPM or PCM DTCs set?
Yes
Refer to other DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
No
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 105 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #14)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

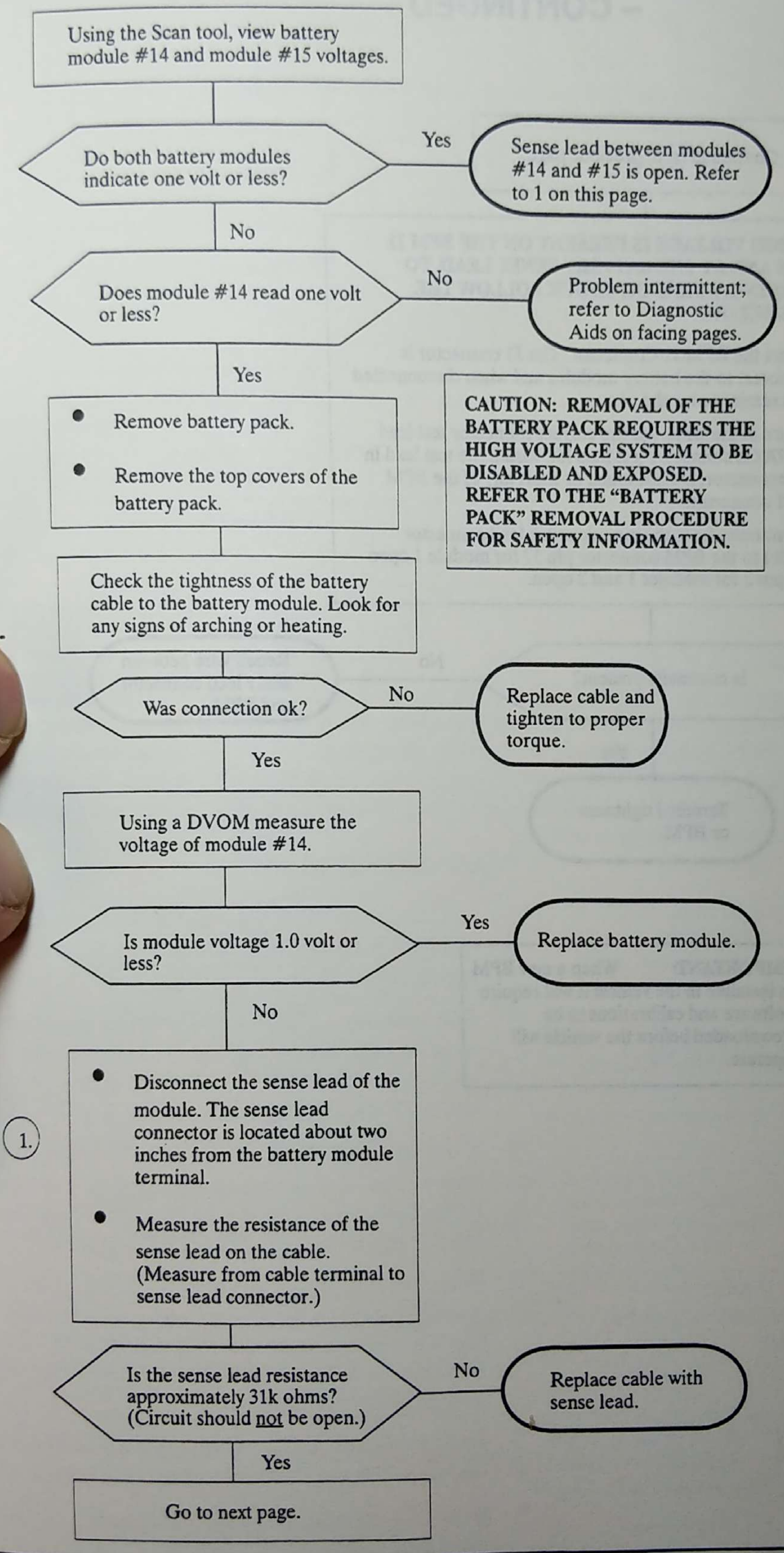
DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:
  1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
  2. Under "HIGH" discharge current (Heavy Load).
  3. When battery module state of charge (SOC) is "LOW."
- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

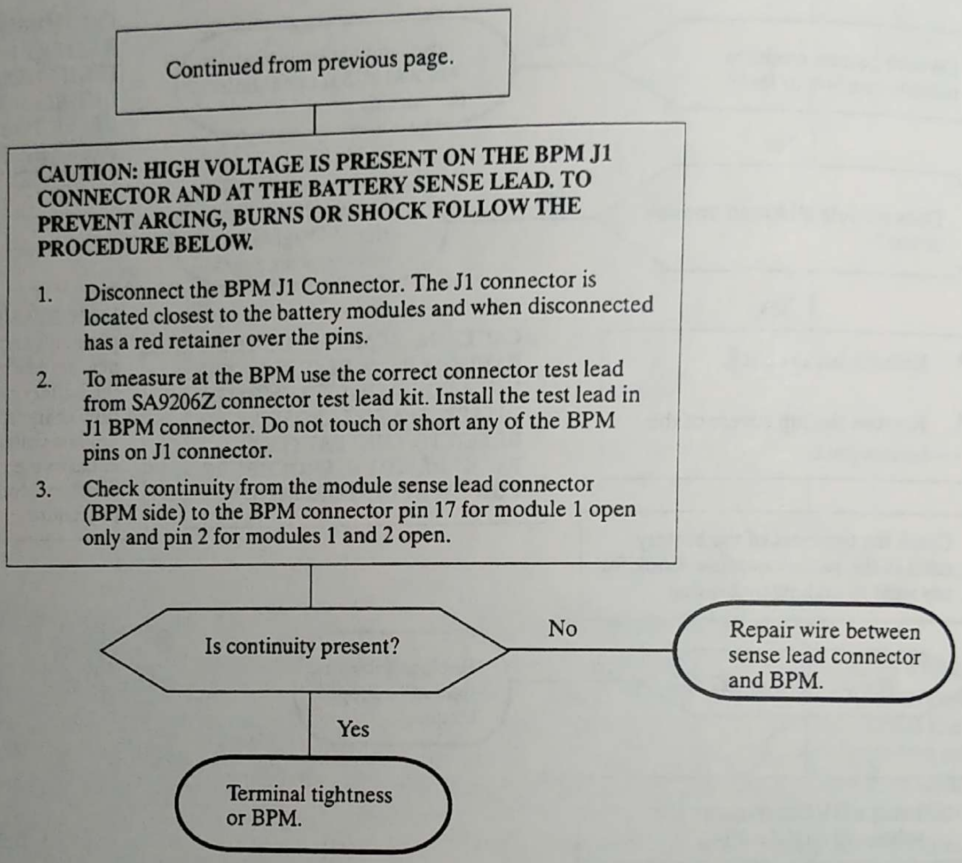
DTC 105
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #14)


Using the Scan tool, view battery module #14 and module #15 voltages.
Do both battery modules indicate one volt or less?
Yes
Sense lead between modules #14 and #15 is open. Refer to 1 on this page.
No
Does module #14 read one volt or less?
No
Problem intermittent; refer to Diagnostic Aids on facing pages.
Yes
Remove battery pack.
Remove the top covers of the battery pack.
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.
Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.
Was connection ok?
No
Replace cable and tighten to proper torque.
Yes
Using a DVOM measure the voltage of module #14.
Is module voltage 1.0 volt or less?
Yes
Replace battery module.
No
1.
Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)
Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)
No
Replace cable with sense lead.
Yes
Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 105
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #14) – CONTINUED


Continued from previous page.
Is continuity present?
No
Repair wire between sense lead connector and BPM.
Yes
Terminal tightness or BPM.

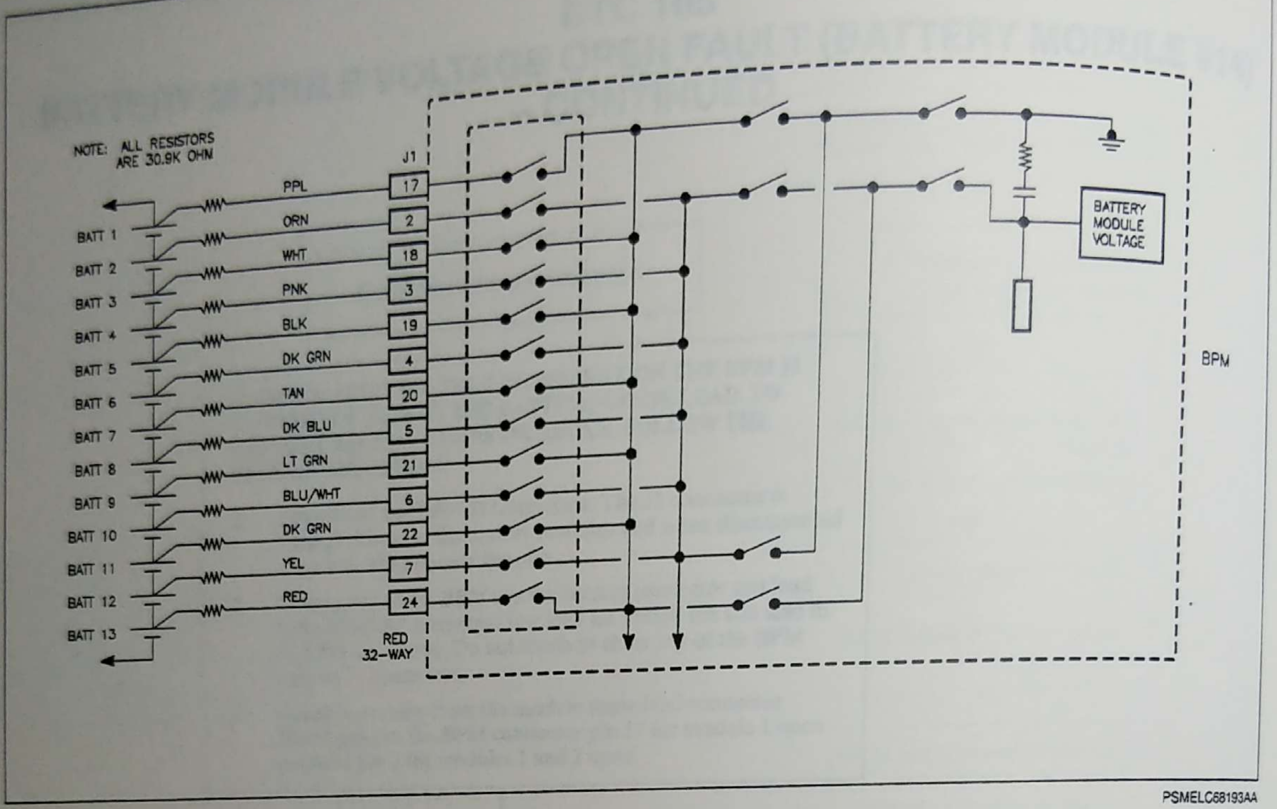
CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 107 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #14)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #14: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

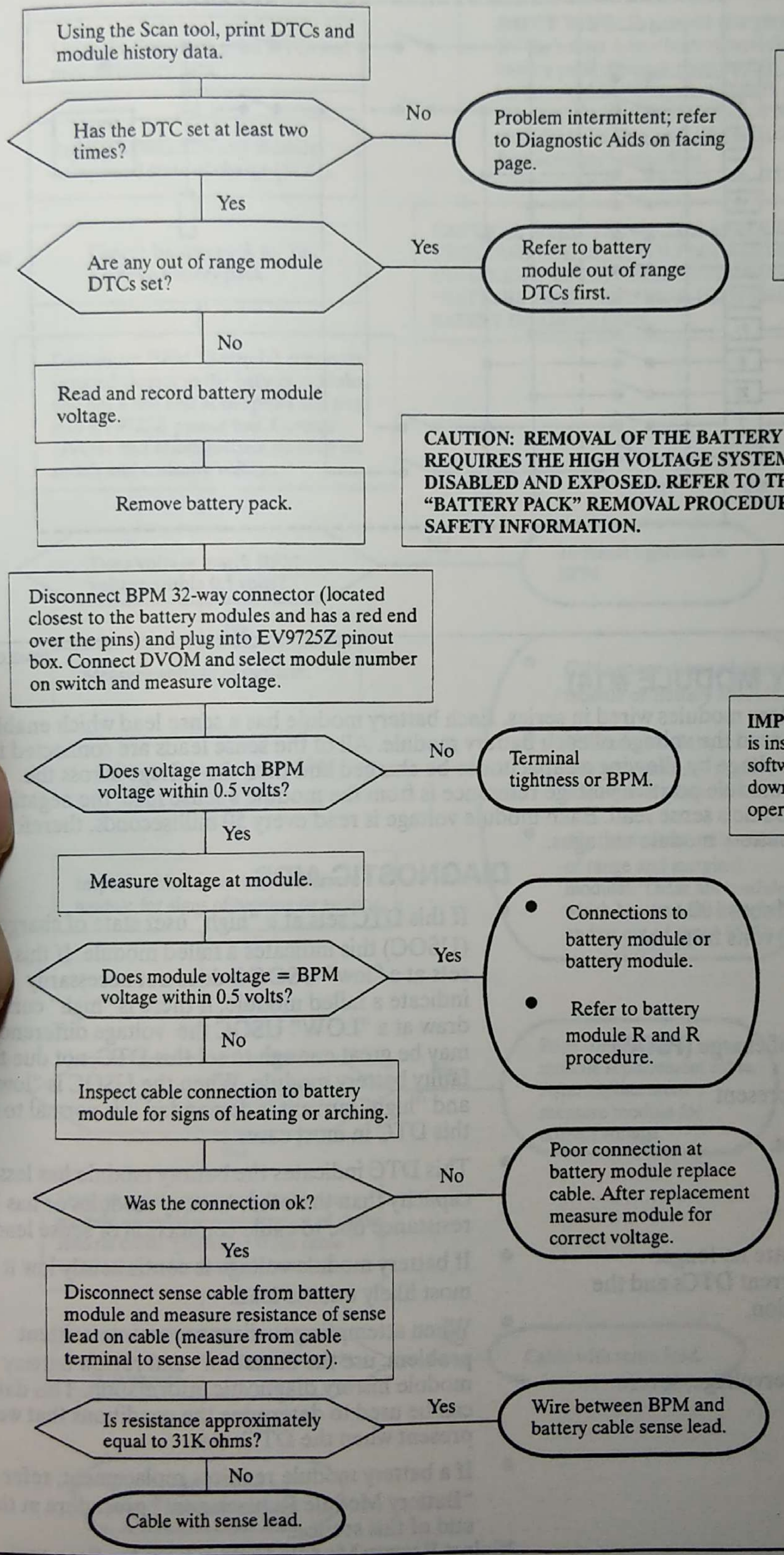
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

DTC 107
MARGINAL (BATTERY MODULE #14)

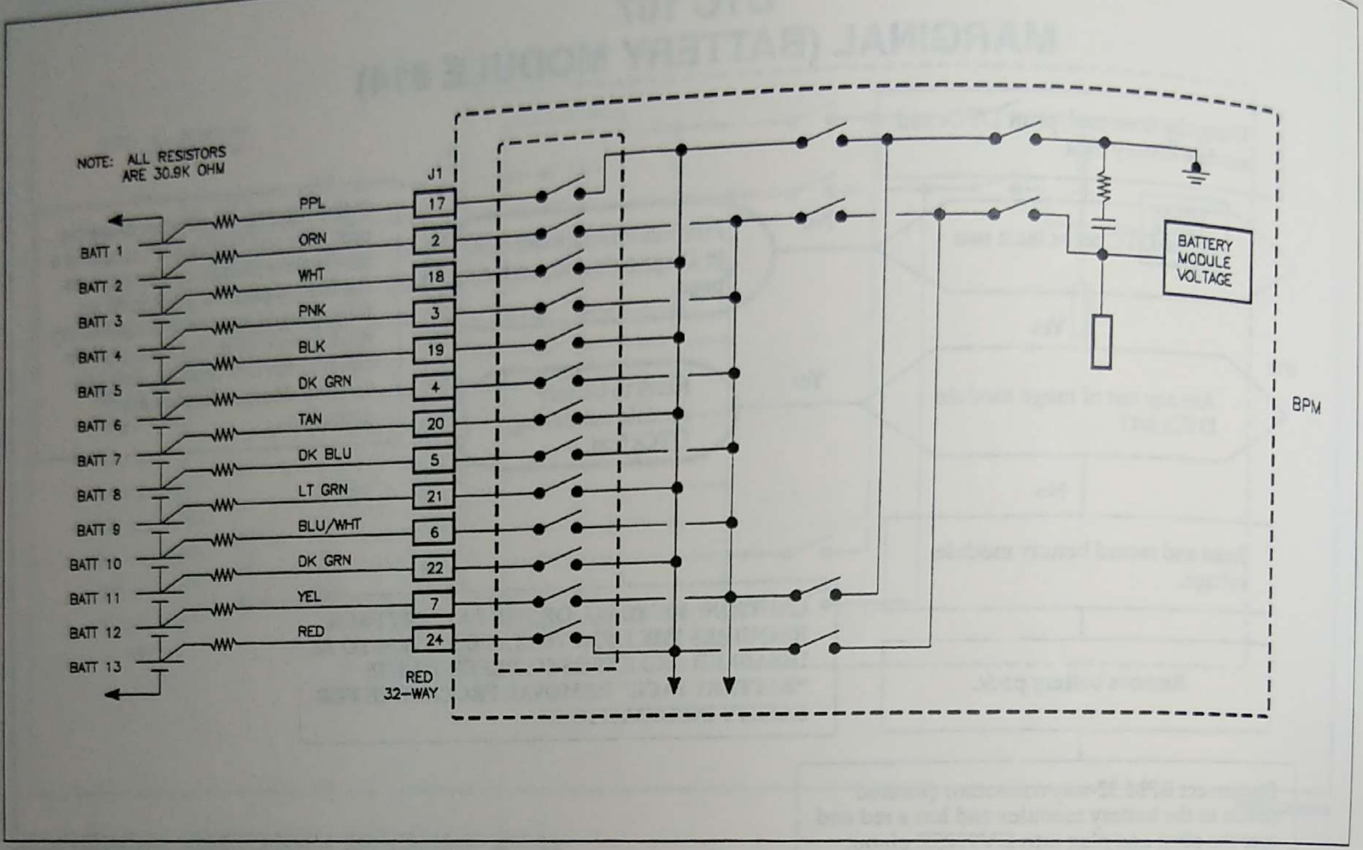

Using the Scan tool, print DTCs and module history data.
Has the DTC set at least two times?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any out of range module DTCs set?
Yes
Refer to battery module out of range DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Connections to battery module or battery module.
• Refer to battery module R and R procedure.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).
Is resistance approximately equal to 31K ohms?
Yes
Wire between BPM and battery cable sense lead.
No
Cable with sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 108 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #14)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #14: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

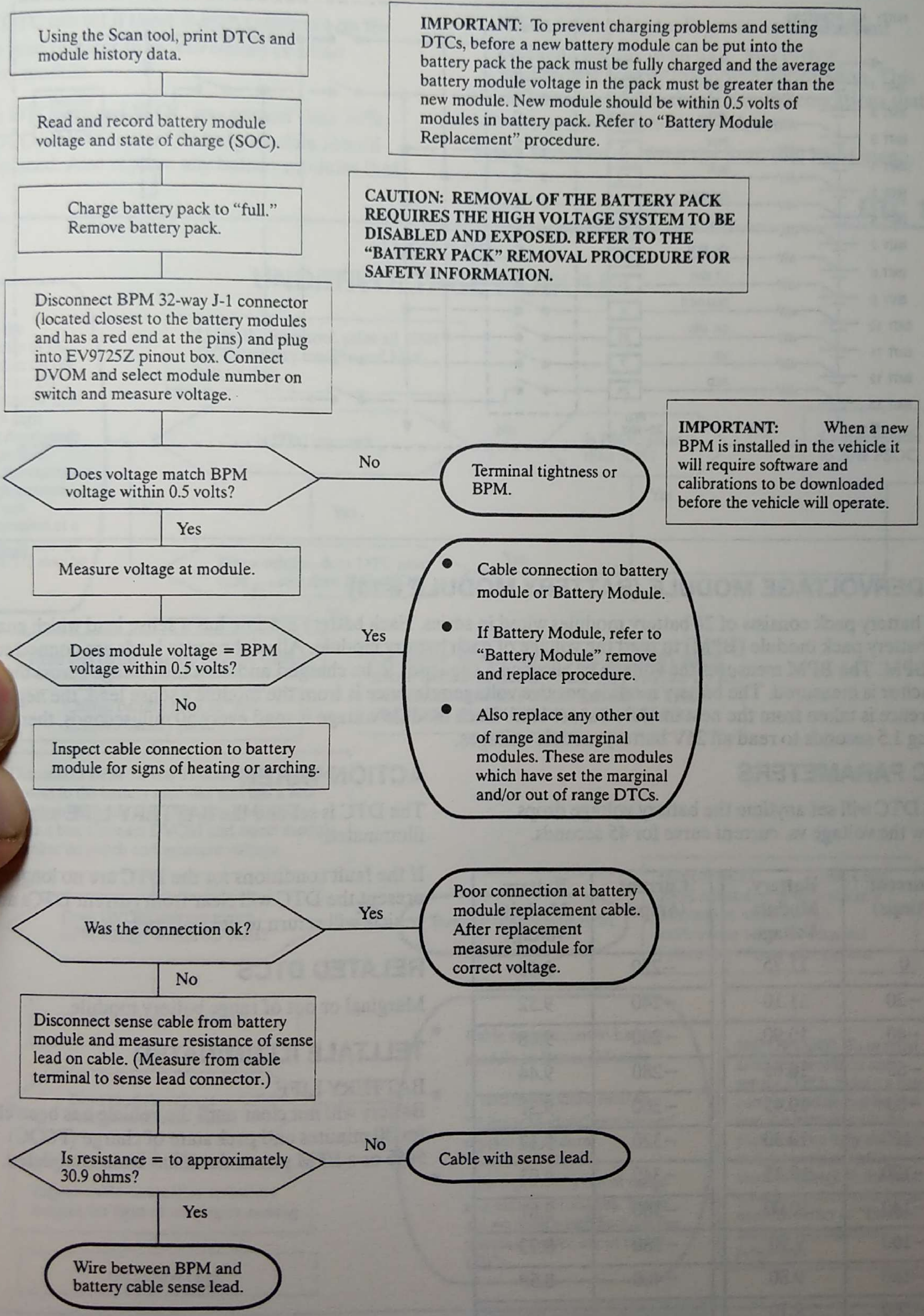
None

DIAGNOSTIC AIDS

- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

*Select Battery Module History from the Scan tool BPM menu.

DTC 108
OUT OF RANGE (BATTERY MODULE #14)



Using the Scan tool, print DTCs and module history data.

Read and record battery module voltage and state of charge (SOC).

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

No: Terminal tightness or BPM.

Yes: Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

Yes:
- Cable connection to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

No: Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Yes: Poor connection at battery module replacement cable. After replacement measure module for correct voltage.

No: Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)

Is resistance = to approximately 30.9 ohms?

No: Cable with sense lead.

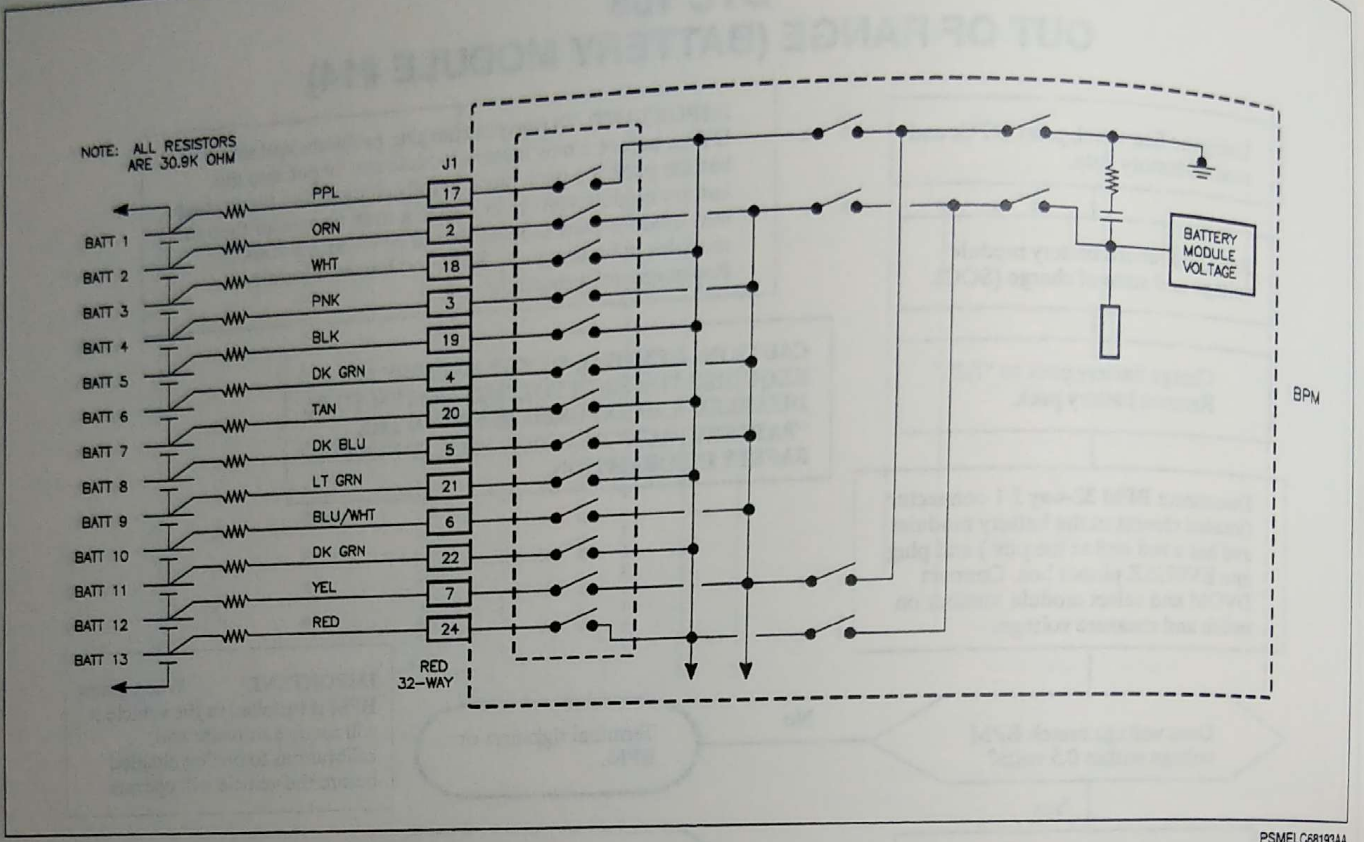
Yes: Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 109 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #14)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage	Current (Amps)	Battery Module Voltage
0	11.75	−220	9.60
−20	11.10	−240	9.52
−40	10.90	−260	9.48
−60	10.65	−280	9.44
−80	10.45	−300	9.31
−100	10.30	−320	9.17
−120	10.15	−340	9.03
−140	10.00	−360	8.87
−160	9.90	−380	8.73
−180	9.80	−400	8.59
−200	9.70		

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

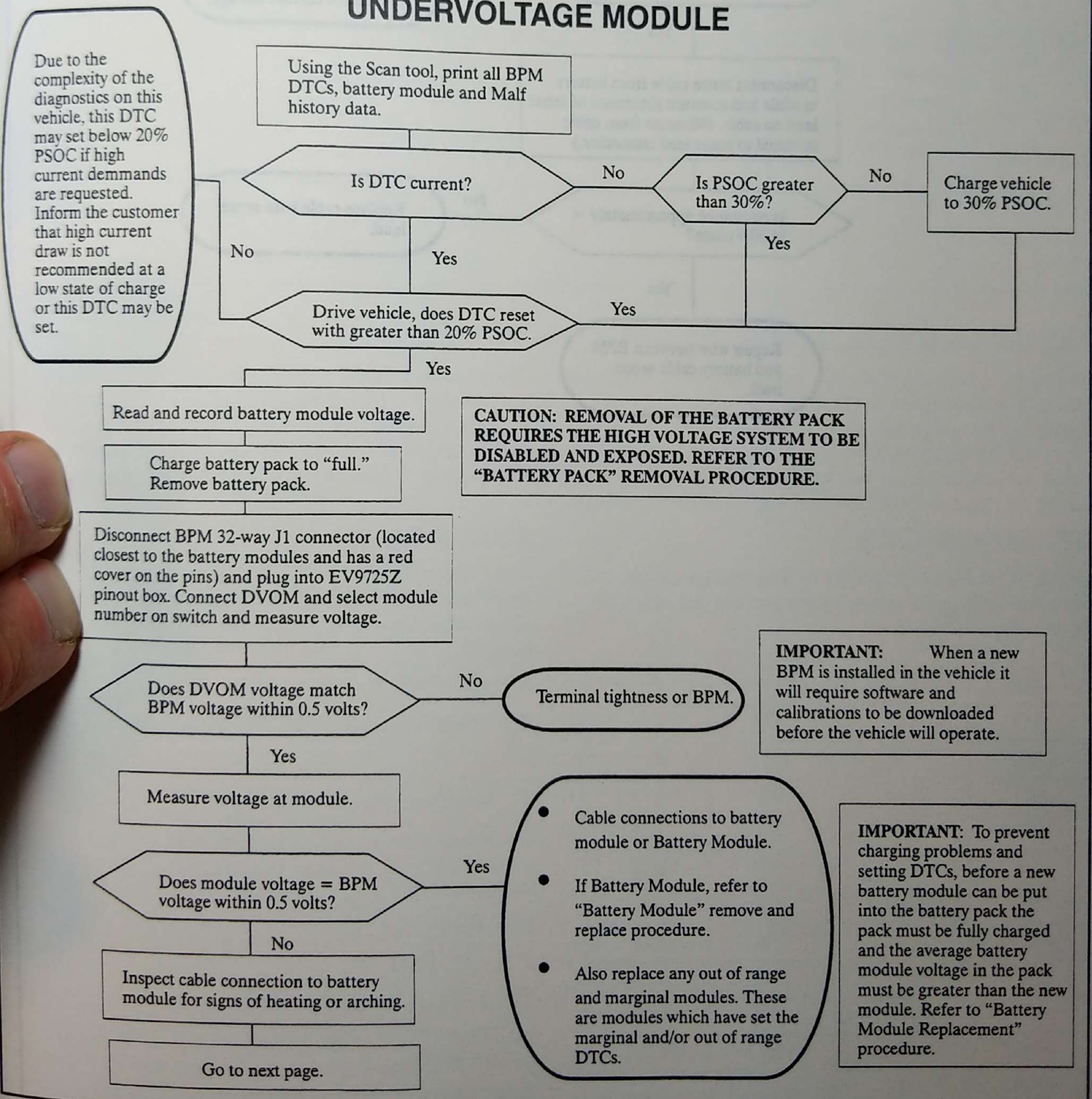
BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below zero percent user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 109
UNDERVOLTAGE MODULE


Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

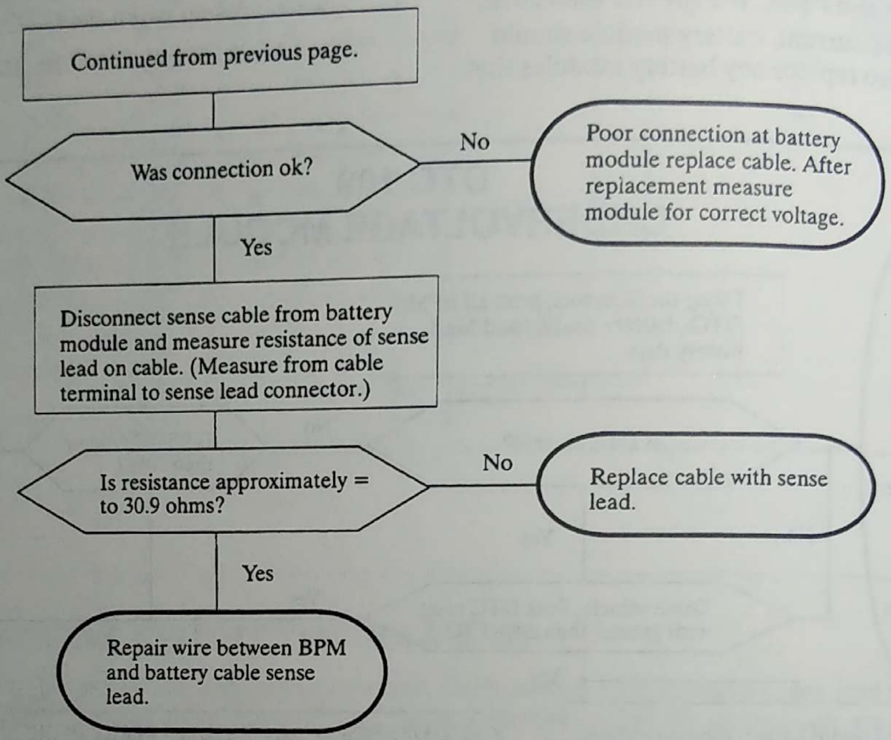
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

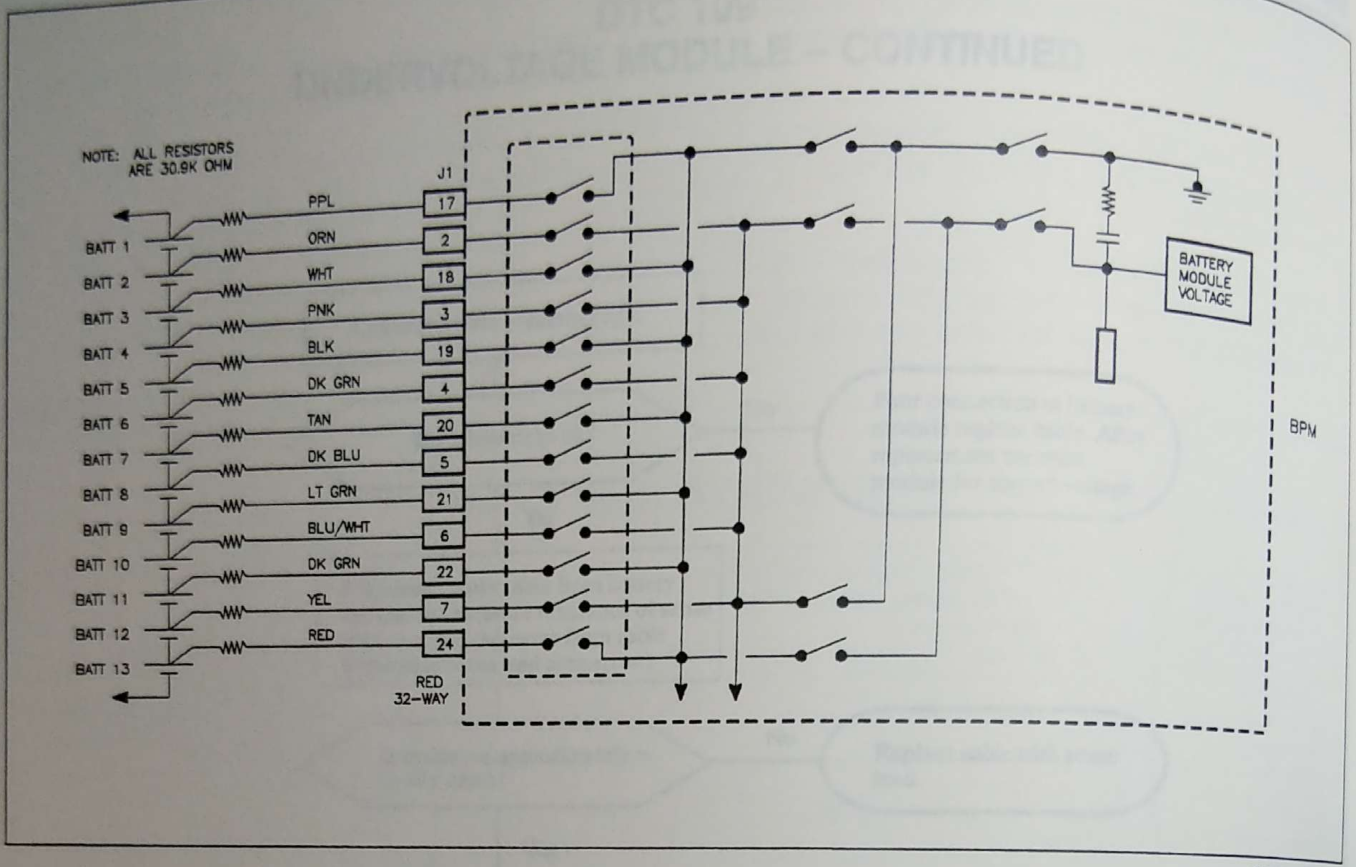
DTC 109

UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 110 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #14)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

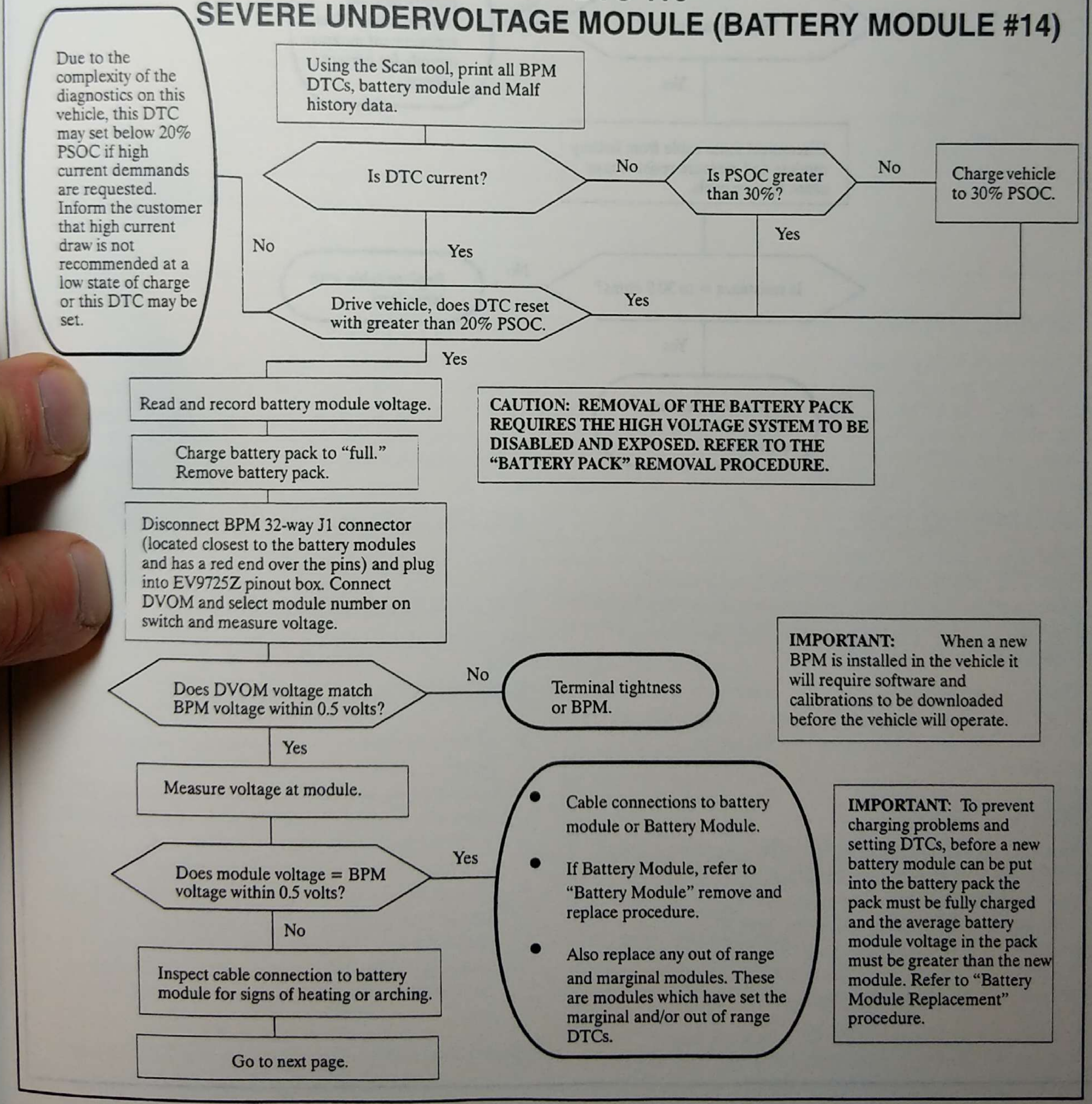
DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches zero percent user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 110

DTC 110
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #14)



Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

Using the Scan tool, print all BPM DTCs, battery module and Malf history data.

Is DTC current?

Is PSOC greater than 30%?

Charge vehicle to 30% PSOC.

Drive vehicle, does DTC reset with greater than 20% PSOC.

Read and record battery module voltage.

Charge battery pack to "full." Remove battery pack.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

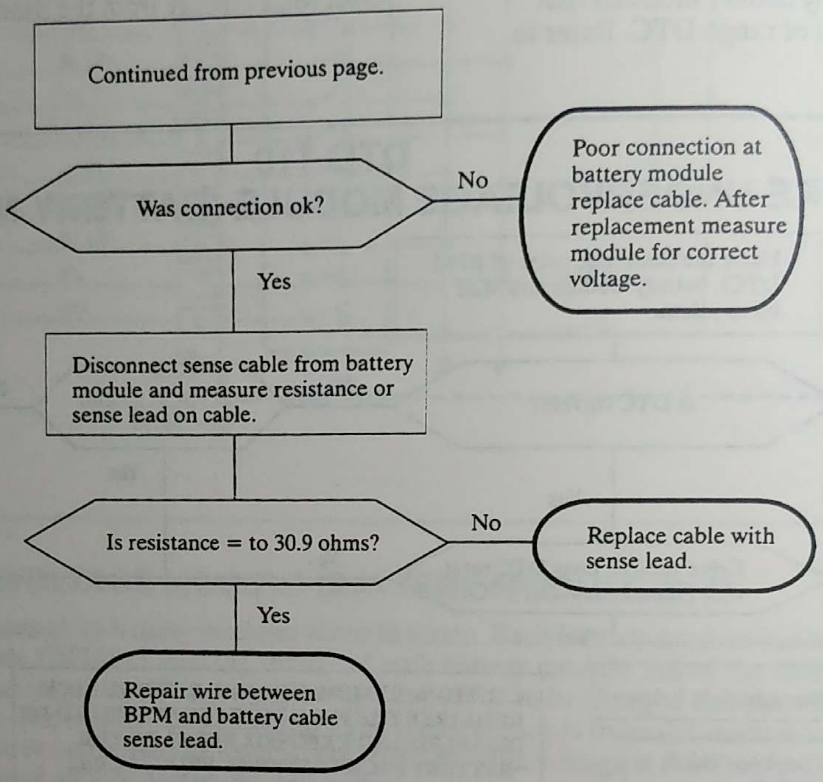
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

Inspect cable connection to battery module for signs of heating or arching.

Go to next page.

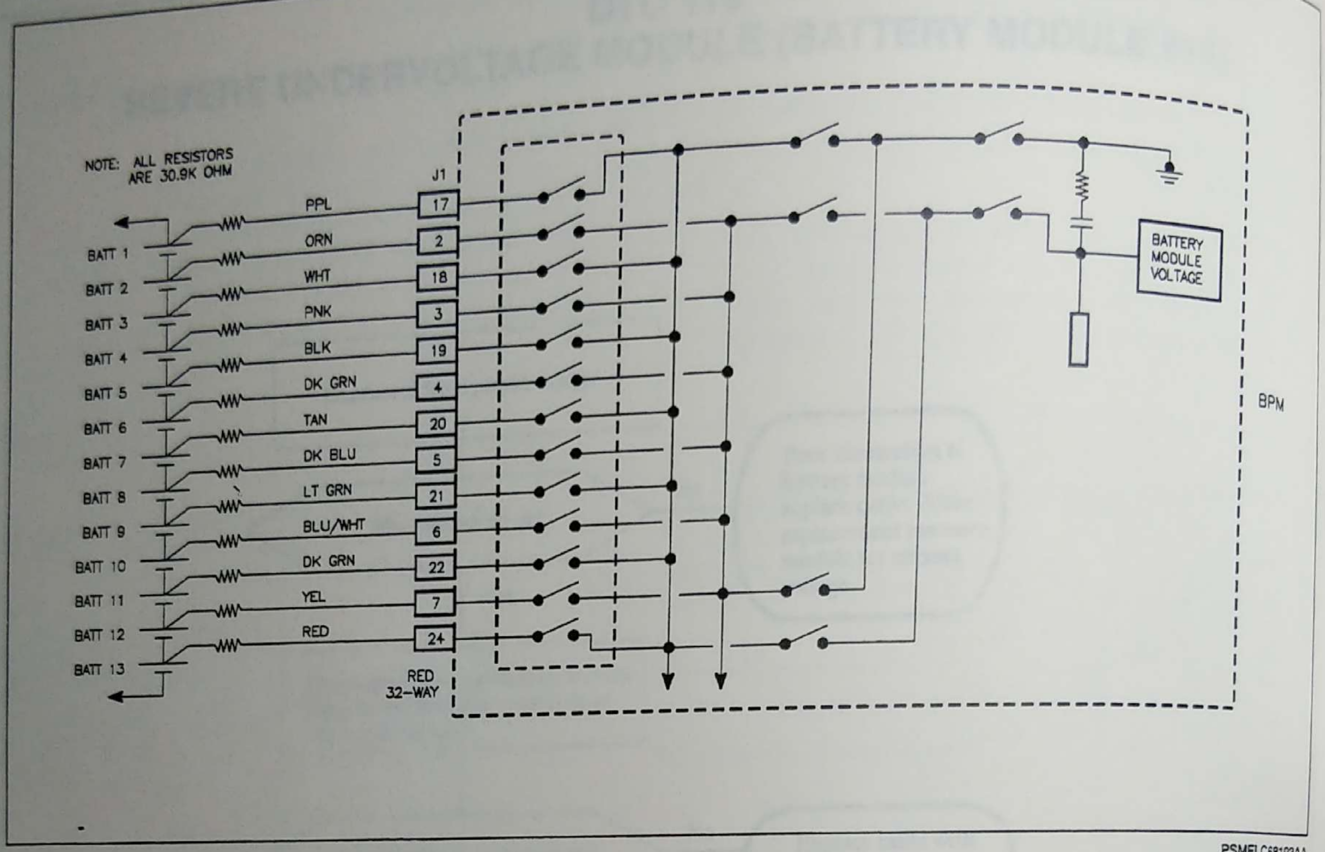
DTC 110

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #14)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 111 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #14)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

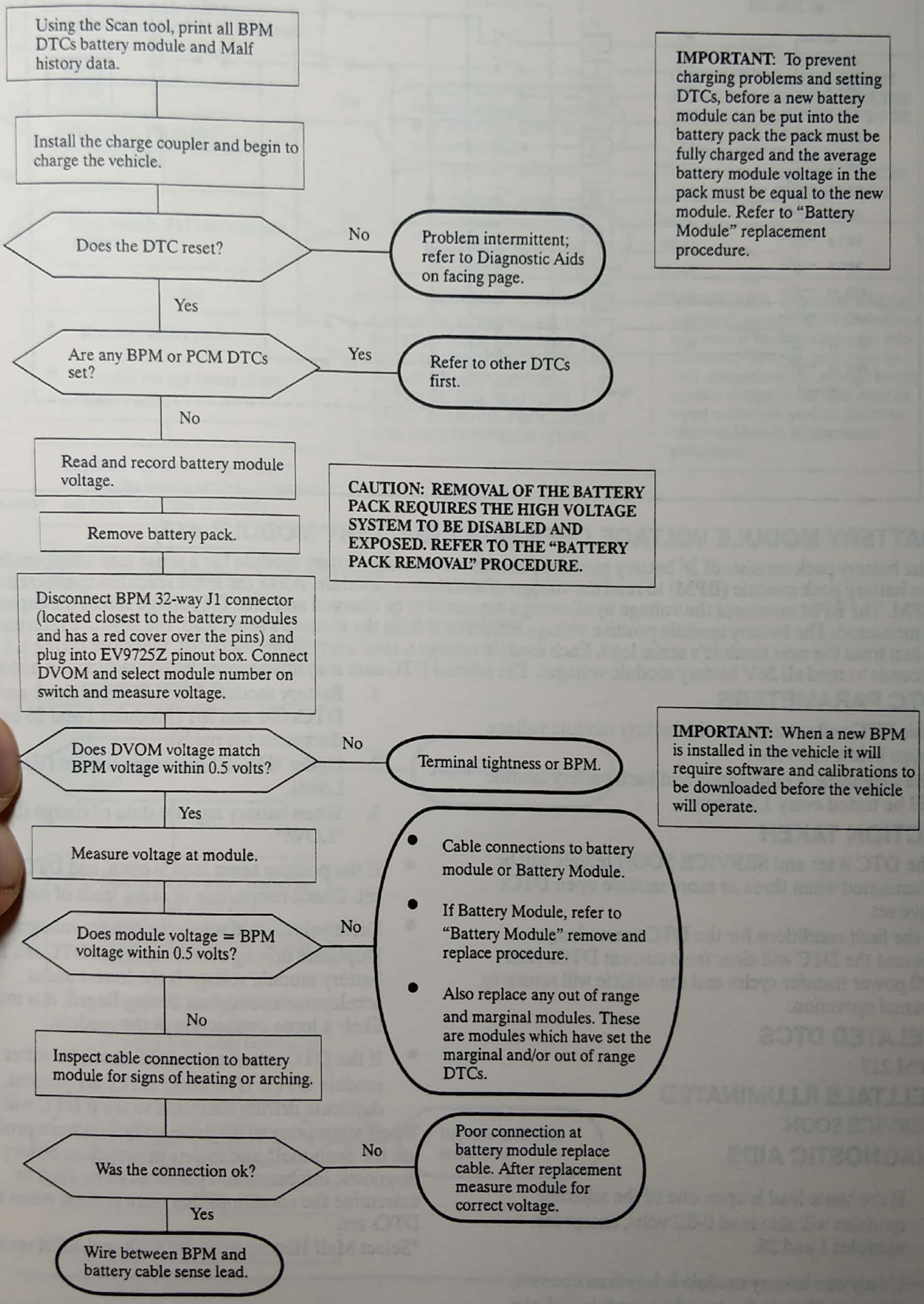
SERVICE NOW and REDUCED PERFORMANCE

DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

DTC 111
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #14)

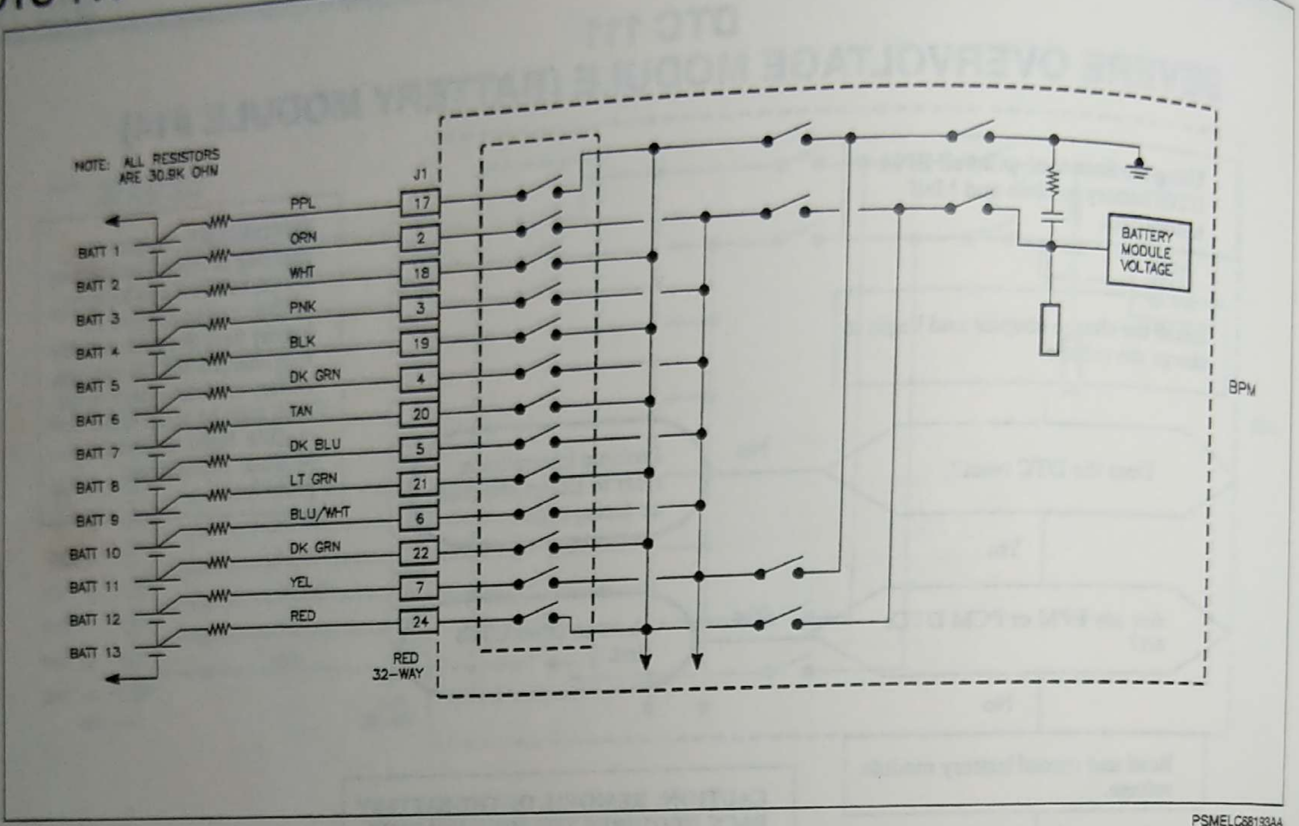

Using the Scan tool, print all BPM DTCs battery module and Malf history data.
Install the charge coupler and begin to charge the vehicle.
Does the DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any BPM or PCM DTCs set?
Yes
Refer to other DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
No
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 113 – BATTERY MODULE VOLTAGE OPEN FAULT



BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #15)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:

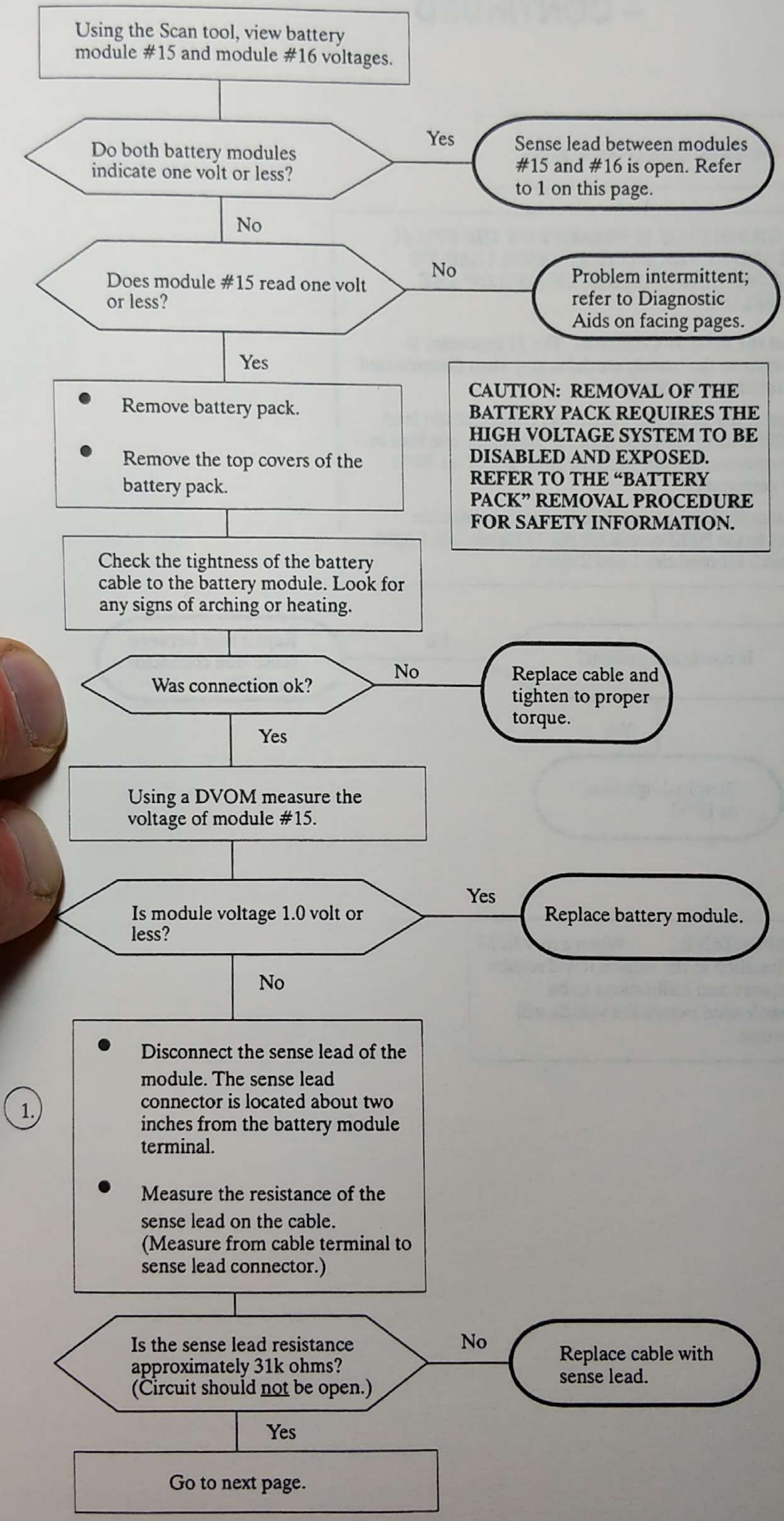
  1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
  2. Under "HIGH" discharge current (Heavy Load).
  3. When battery module state of charge (SOC) is "LOW."

- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 113
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #15)


Using the Scan tool, view battery module #15 and module #16 voltages.
Do both battery modules indicate one volt or less?
Yes
Sense lead between modules #15 and #16 is open. Refer to 1 on this page.
No
Does module #15 read one volt or less?
No
Problem intermittent; refer to Diagnostic Aids on facing pages.
Yes
Remove battery pack.
Remove the top covers of the battery pack.
Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.
Was connection ok?
No
Replace cable and tighten to proper torque.
Yes
Using a DVOM measure the voltage of module #15.
Is module voltage 1.0 volt or less?
Yes
Replace battery module.
No
1.
Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)
Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)
No
Replace cable with sense lead.
Yes
Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

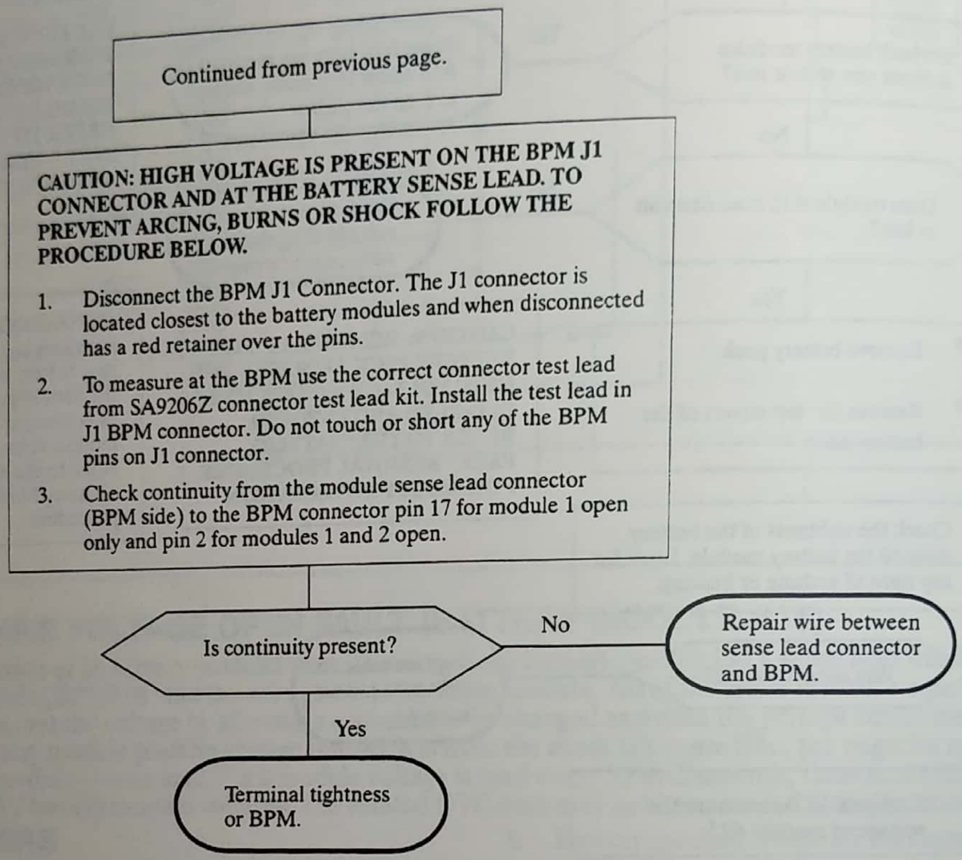
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CS CamScanner

DTC 113

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #15) – CONTINUED



Continued from previous page.

CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

Is continuity present?

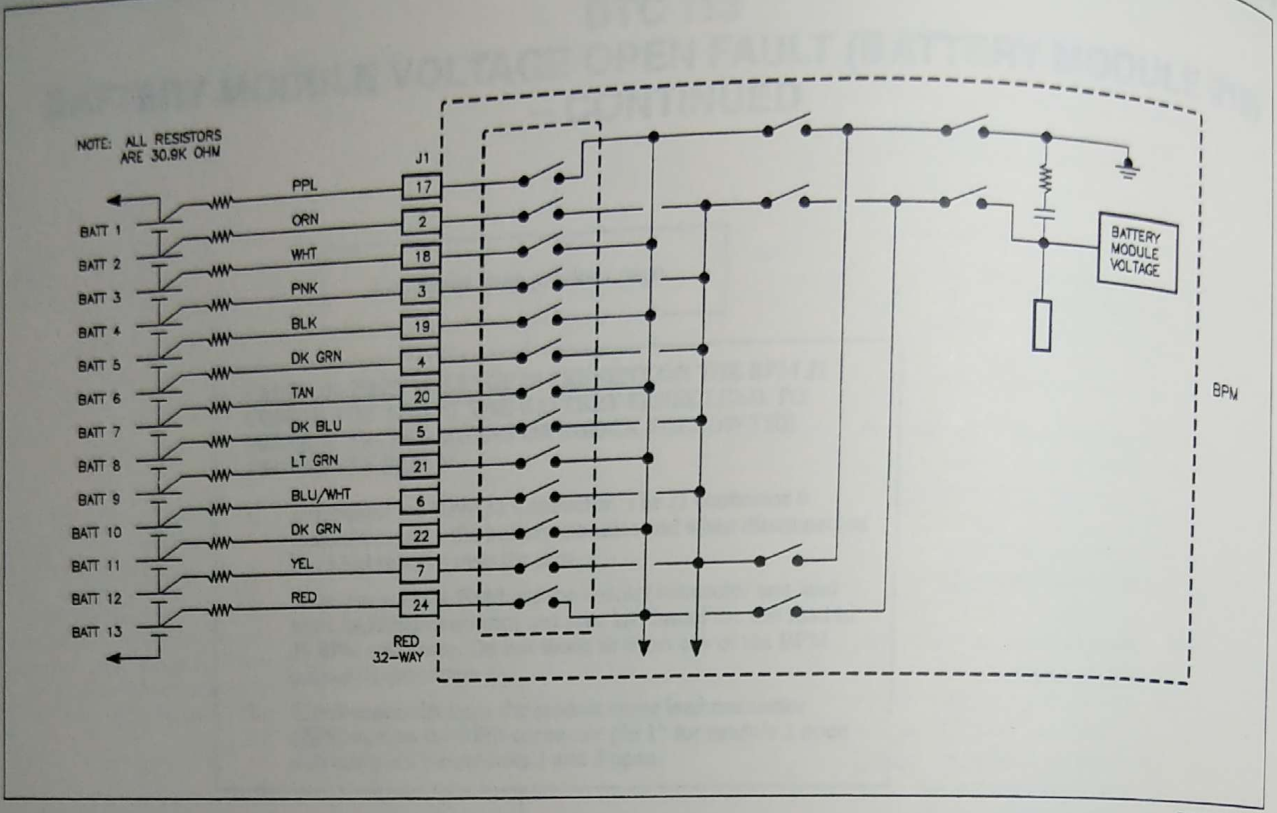
Repair wire between sense lead connector and BPM.

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 115 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #15)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #15: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

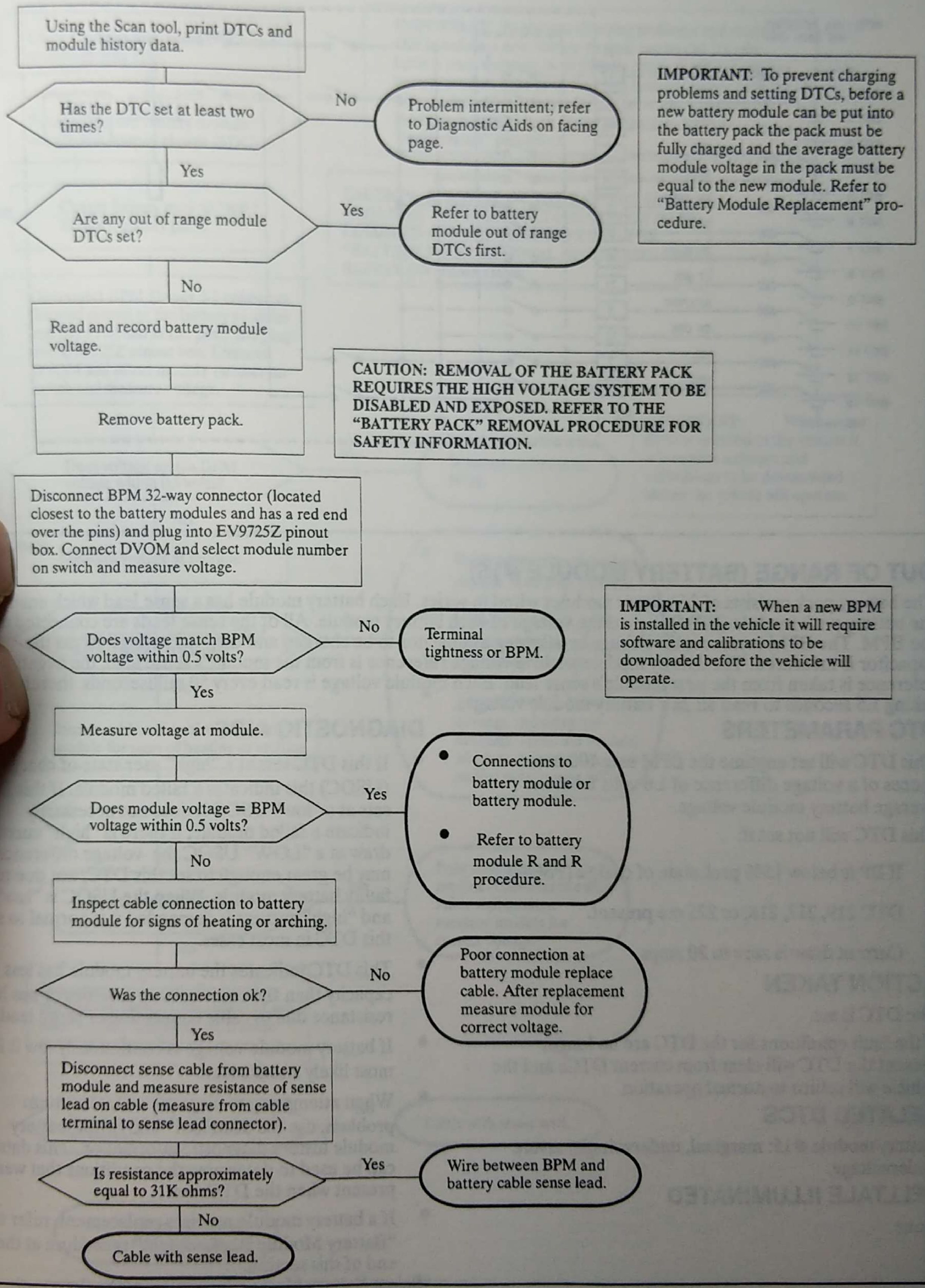
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

DTC 115
MARGINAL (BATTERY MODULE #15)

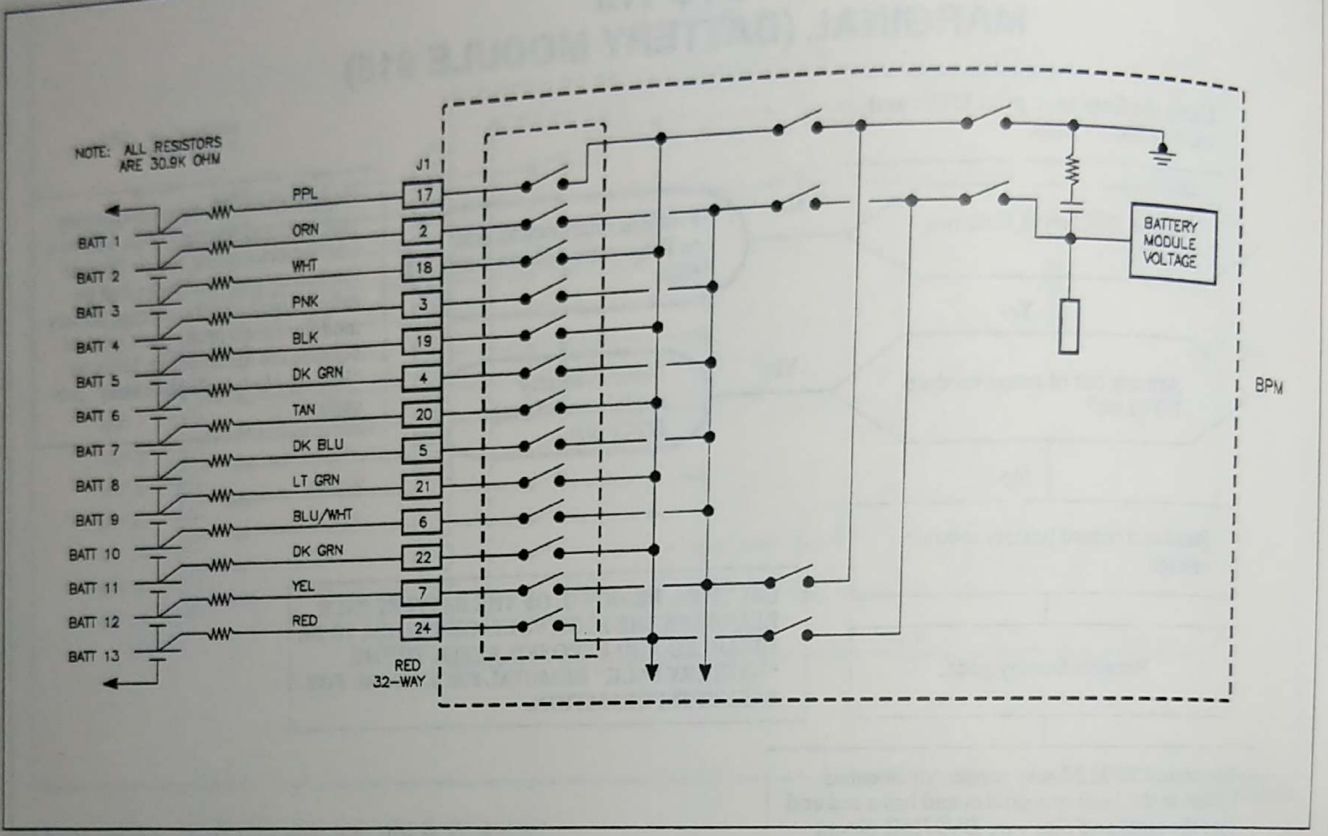

Using the Scan tool, print DTCs and module history data.
Has the DTC set at least two times?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any out of range module DTCs set?
Yes
Refer to battery module out of range DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Connections to battery module or battery module.
• Refer to battery module R and R procedure.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).
Is resistance approximately equal to 31K ohms?
Yes
Wire between BPM and battery cable sense lead.
No
Cable with sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 116 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #15)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #15: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

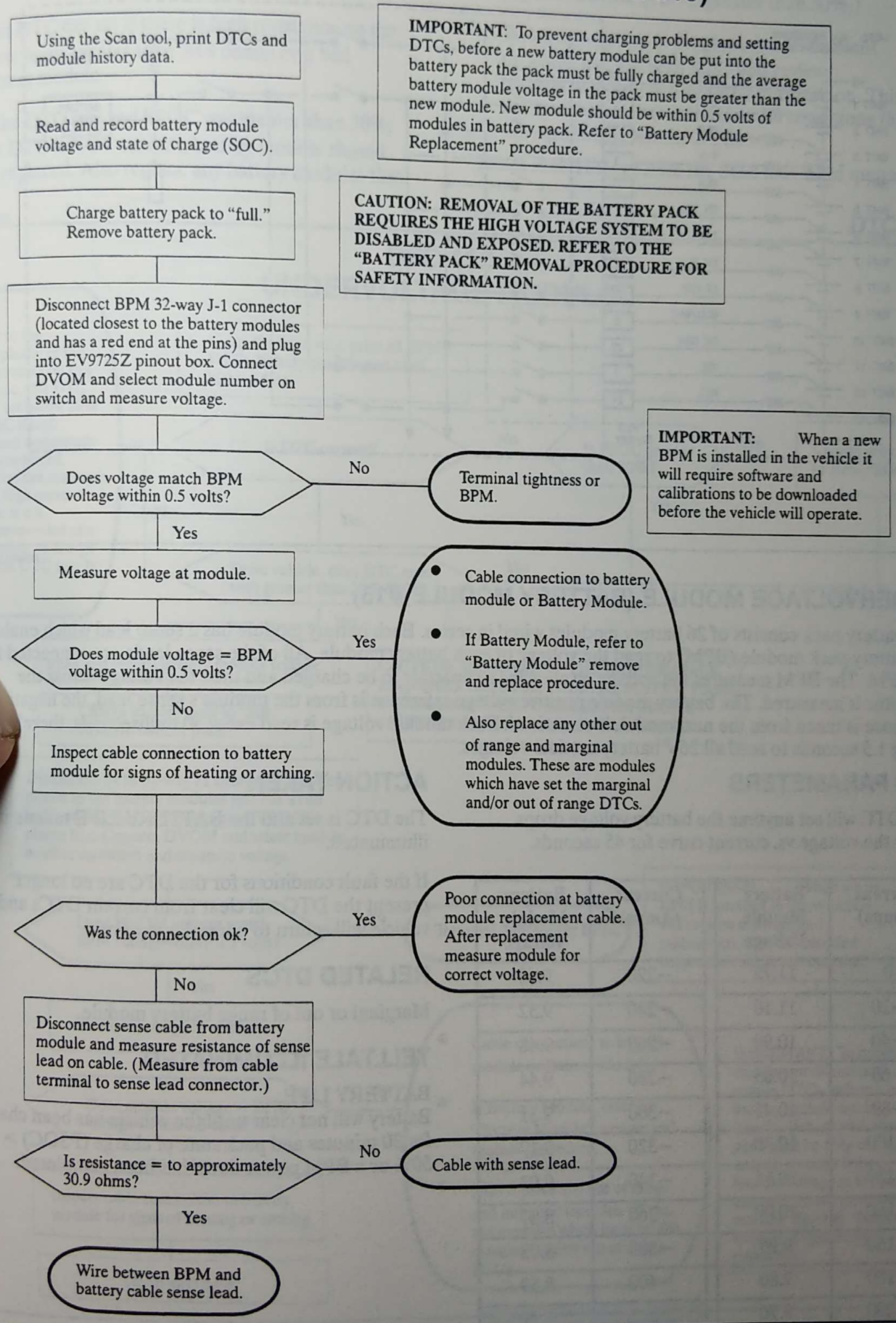
None

DIAGNOSTIC AIDS

- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

*Select Battery Module History from the Scan tool BPM menu.

DTC 116
OUT OF RANGE (BATTERY MODULE #15)



IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

Using the Scan tool, print DTCs and module history data.

Read and record battery module voltage and state of charge (SOC).

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

No: Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

Yes: Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

Yes:
- Cable connection to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

No: Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Yes: Poor connection at battery module replacement cable. After replacement measure module for correct voltage.

No: Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)

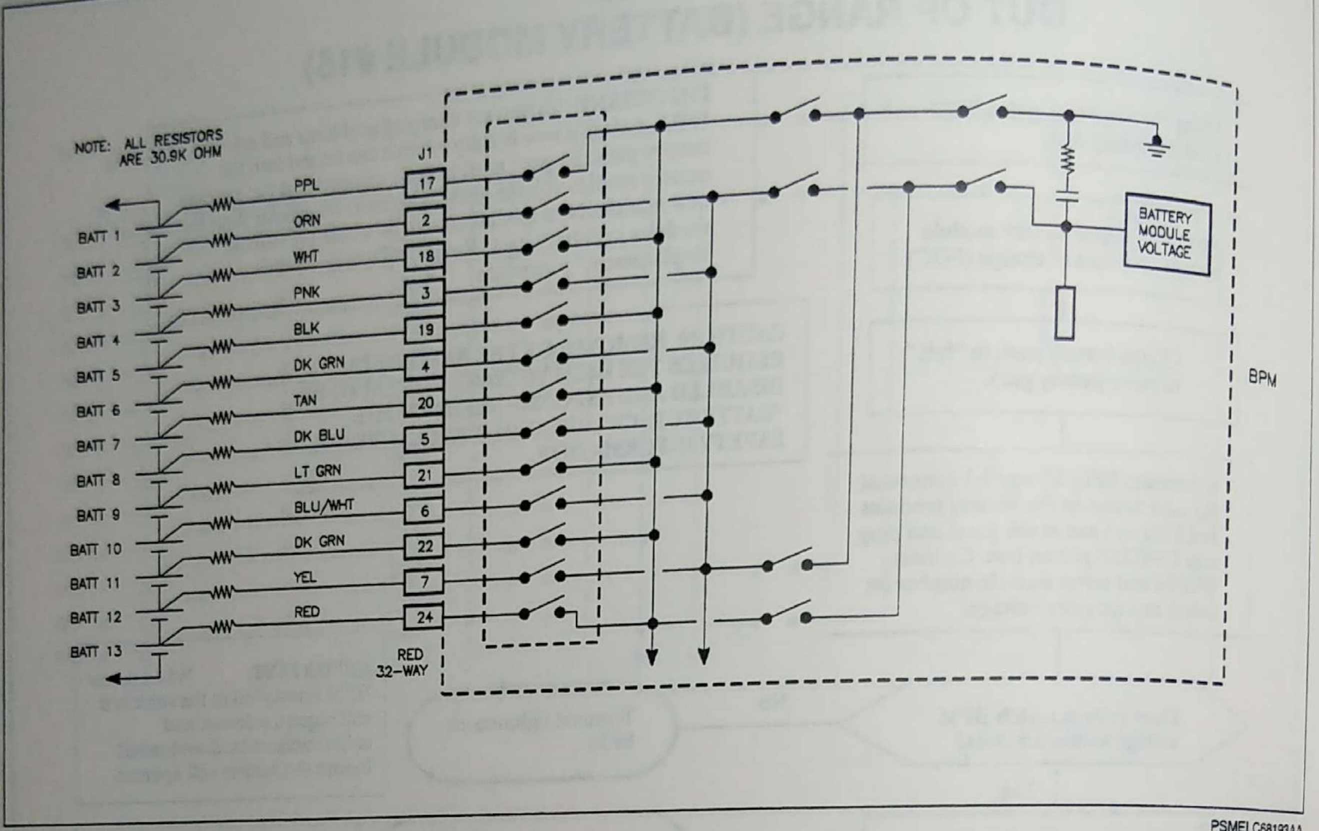
Is resistance = to approximately 30.9 ohms?

No: Cable with sense lead.

Yes: Wire between BPM and battery cable sense lead.

CS CamScanner

DTC 117 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
17
ORN
2
WHT
18
PNK
3
BLK
19
DK GRN
4
TAN
20
DK BLU
5
LT GRN
21
BLU/WHT
6
DK GRN
22
YEL
7
RED
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #15)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage	Current (Amps)	Battery Module Voltage
0	11.75	−220	9.60
−20	11.10	−240	9.52
−40	10.90	−260	9.48
−60	10.65	−280	9.44
−80	10.45	−300	9.31
−100	10.30	−320	9.17
−120	10.15	−340	9.03
−140	10.00	−360	8.87
−160	9.90	−380	8.73
−180	9.80	−400	8.59
−200	9.70		

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

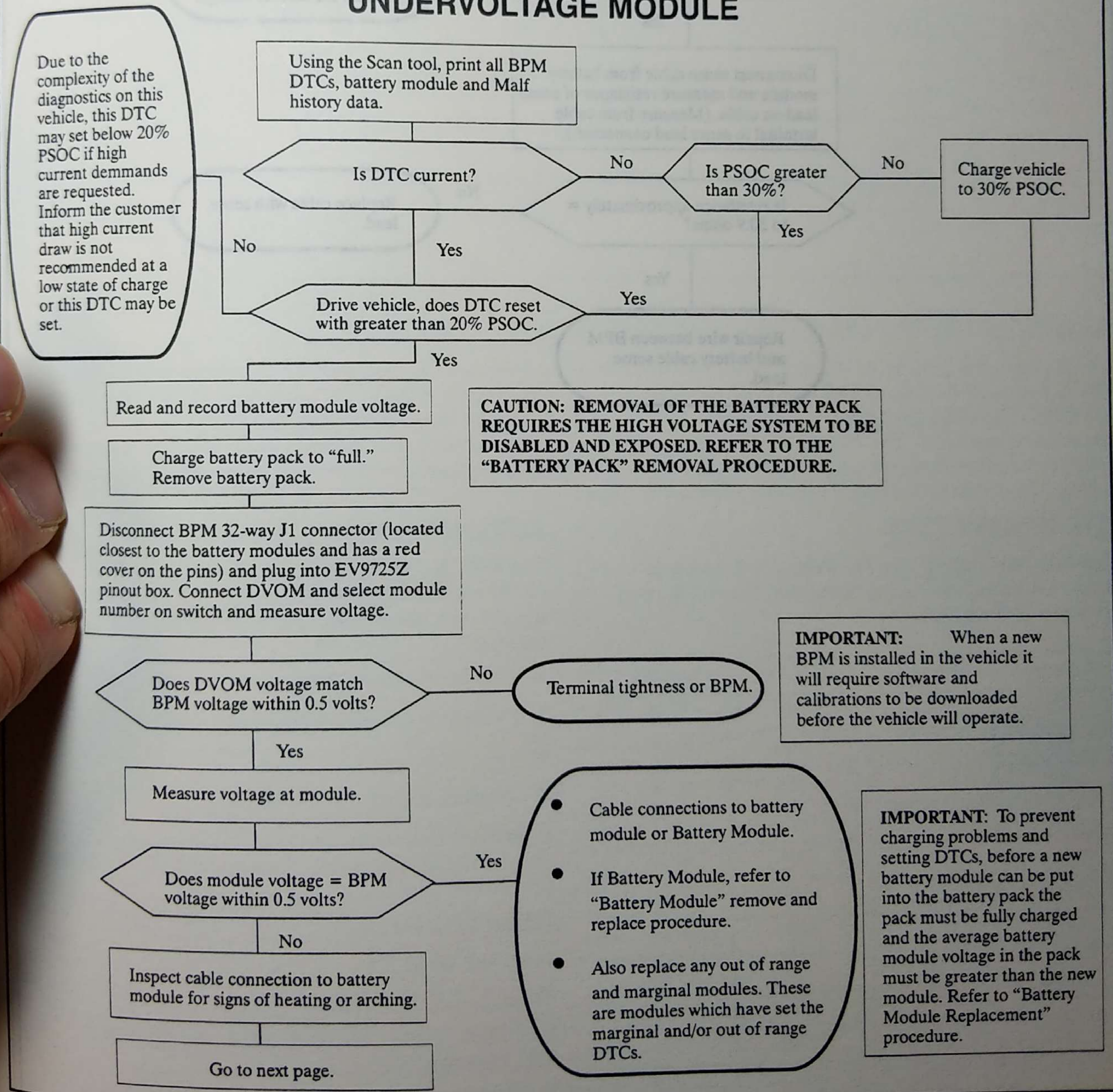
BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below zero percent user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 117
UNDERVOLTAGE MODULE


Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

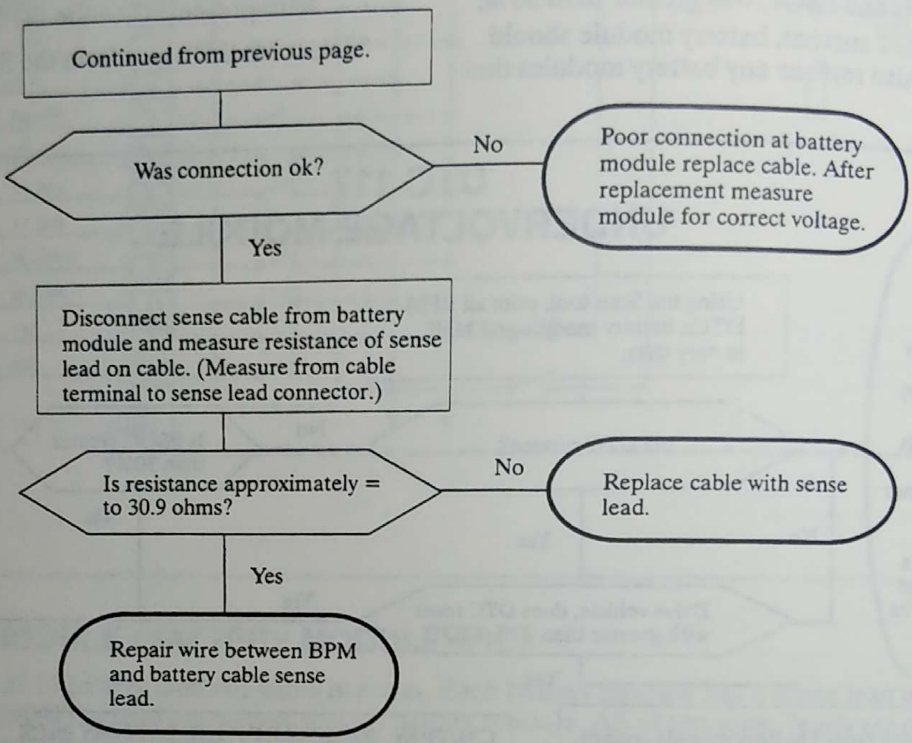
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

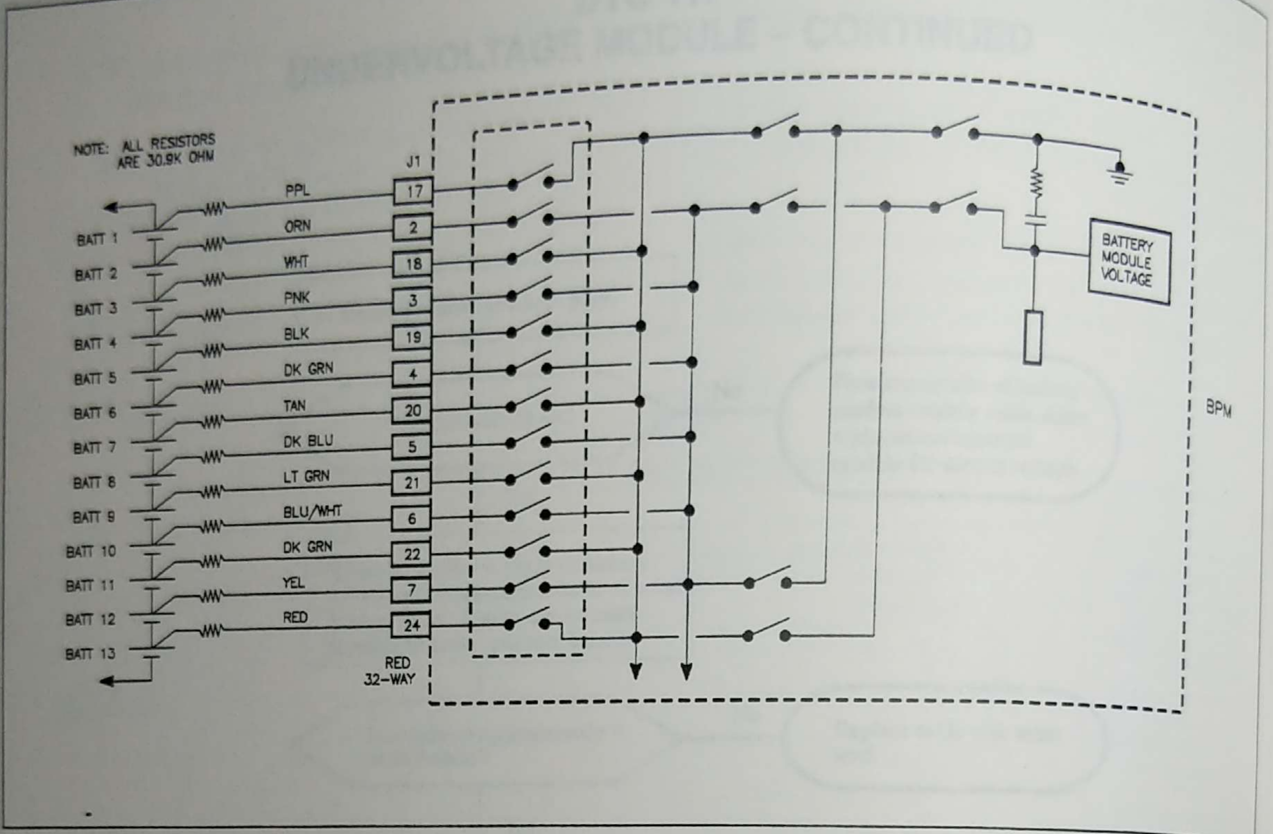
DTC 117

UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 118 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #15)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

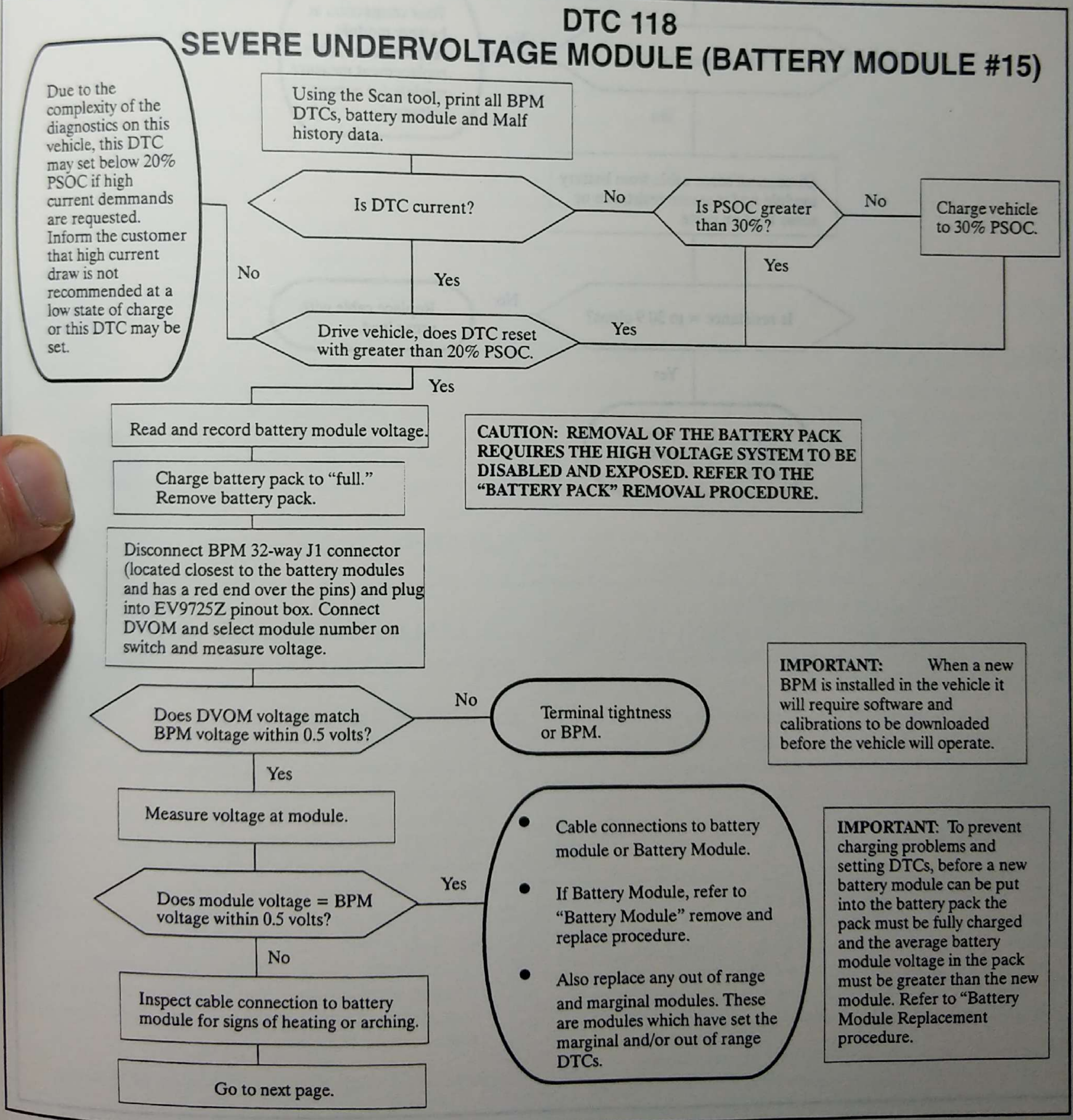
Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches zero percent user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 118
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #15)


Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
Cable connections to battery module or Battery Module.
If Battery Module, refer to "Battery Module" remove and replace procedure.
Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

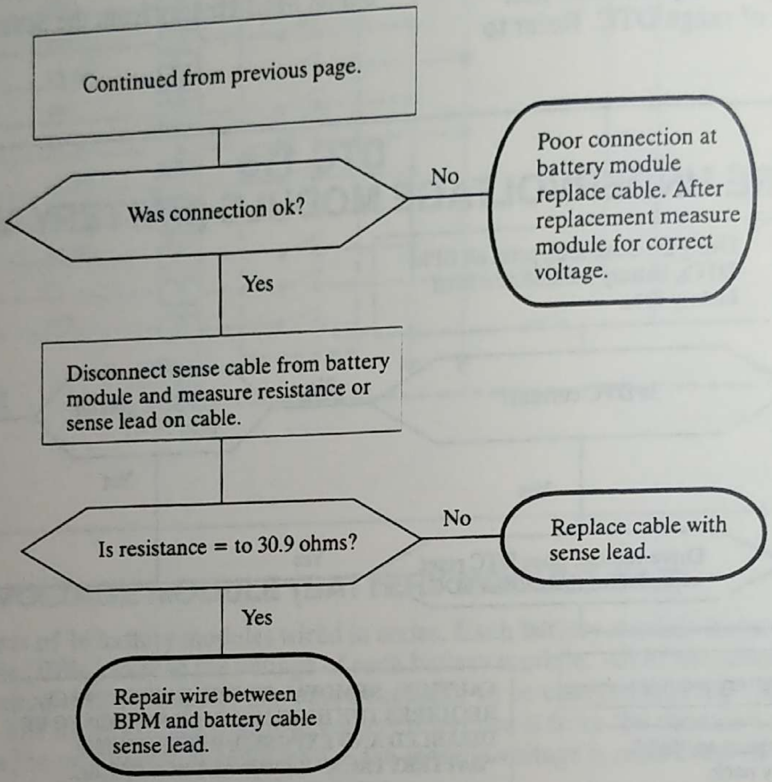
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement procedure.

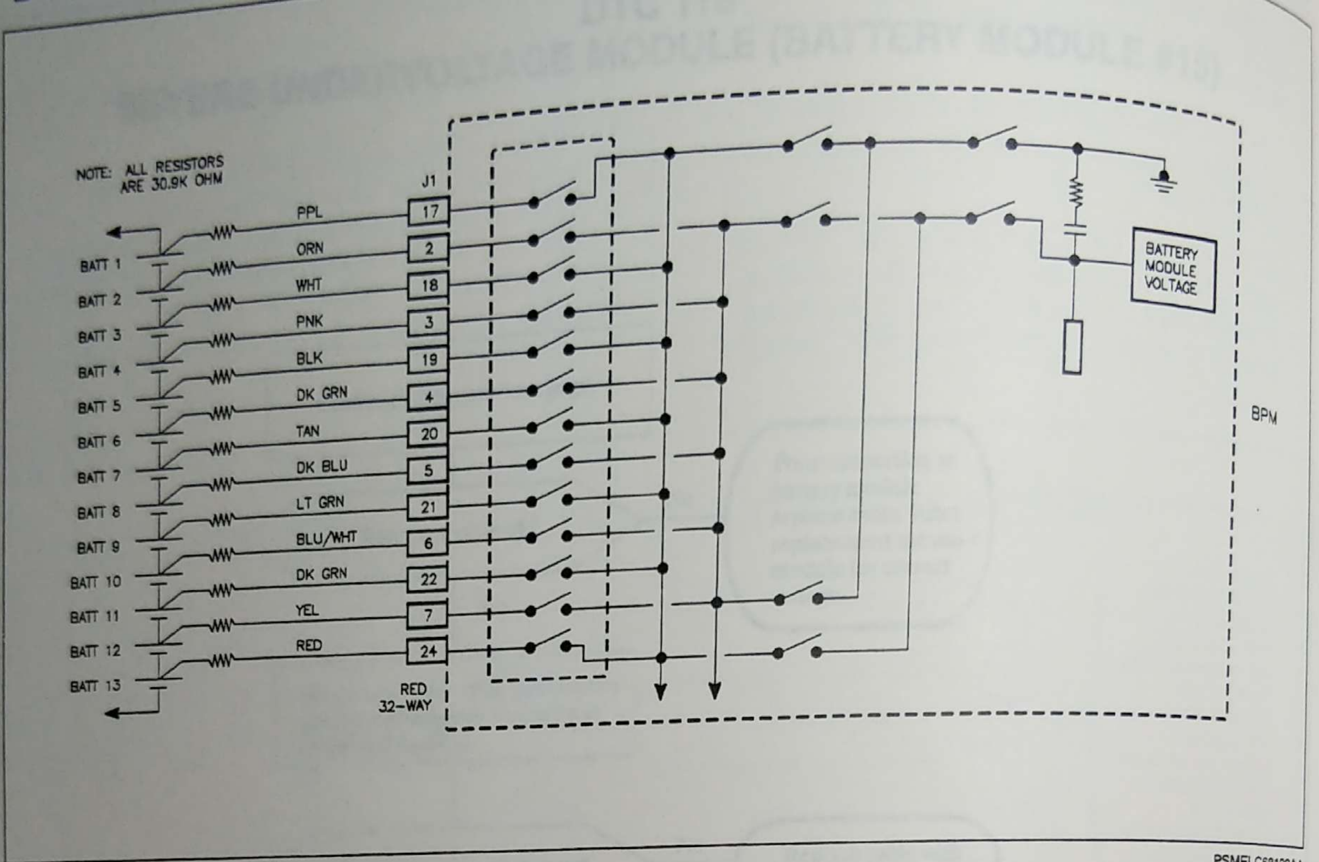
DTC 118

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #15)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 119 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #15)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

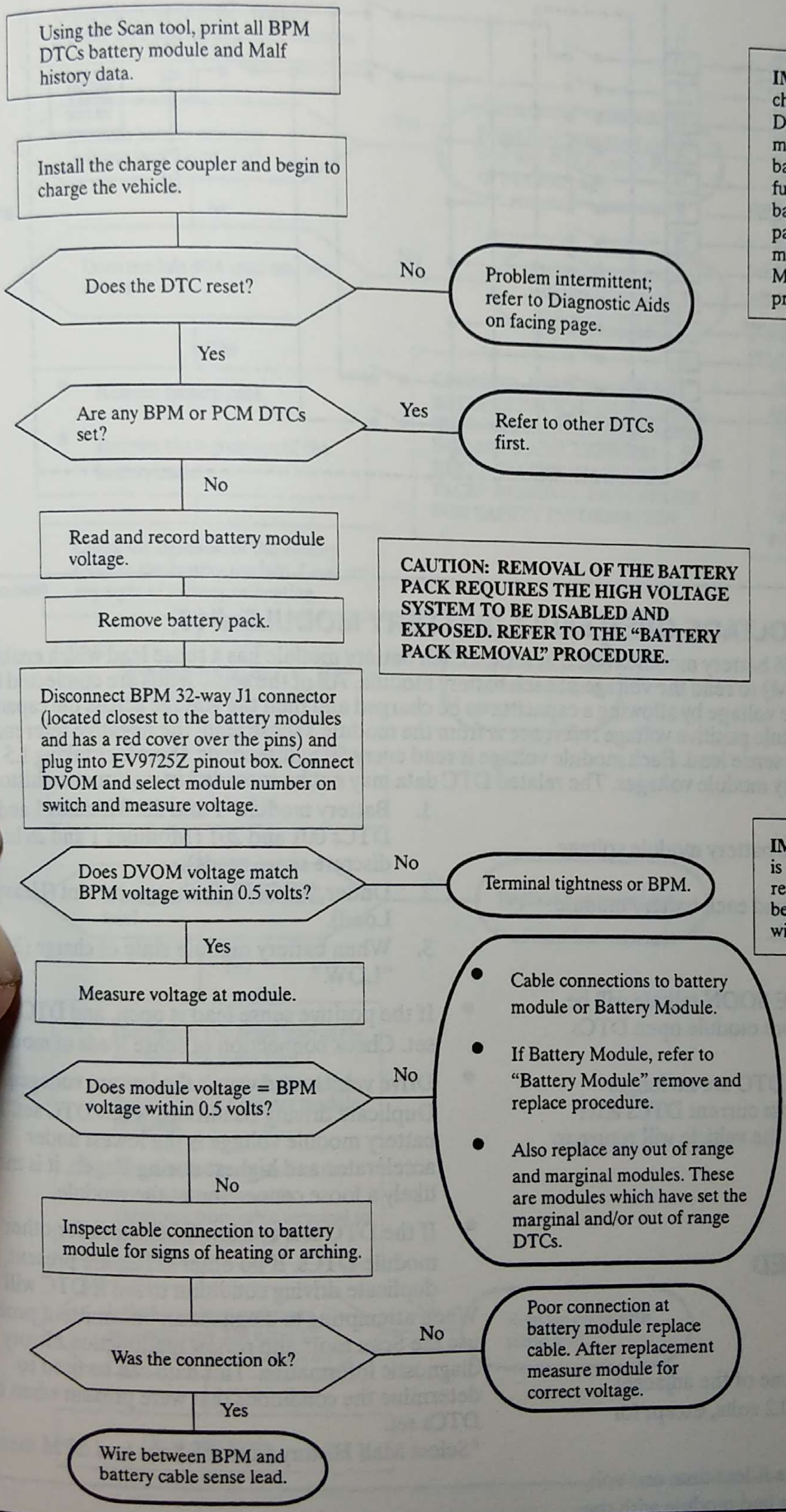
SERVICE NOW and REDUCED PERFORMANCE

DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

DTC 119
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #15)



Using the Scan tool, print all BPM DTCs battery module and Malf history data.

Install the charge coupler and begin to charge the vehicle.

Does the DTC reset?

Problem intermittent; refer to Diagnostic Aids on facing page.

Are any BPM or PCM DTCs set?

Refer to other DTCs first.

Read and record battery module voltage.

Remove battery pack.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Poor connection at battery module replace cable. After replacement measure module for correct voltage.

Wire between BPM and battery cable sense lead.

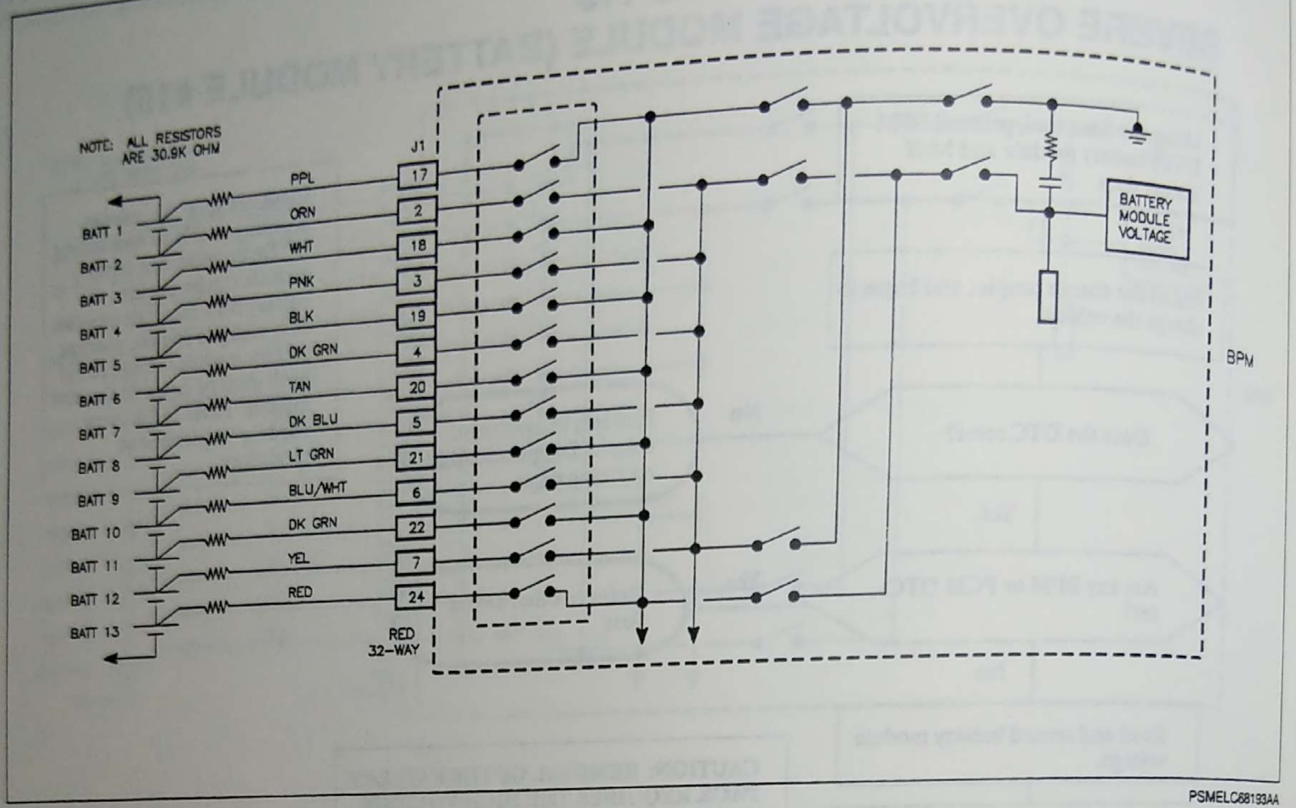
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

CS CamScanner

DTC 121 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #16)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:

1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
2. Under "HIGH" discharge current (Heavy Load).
3. When battery module state of charge (SOC) is "LOW."

- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

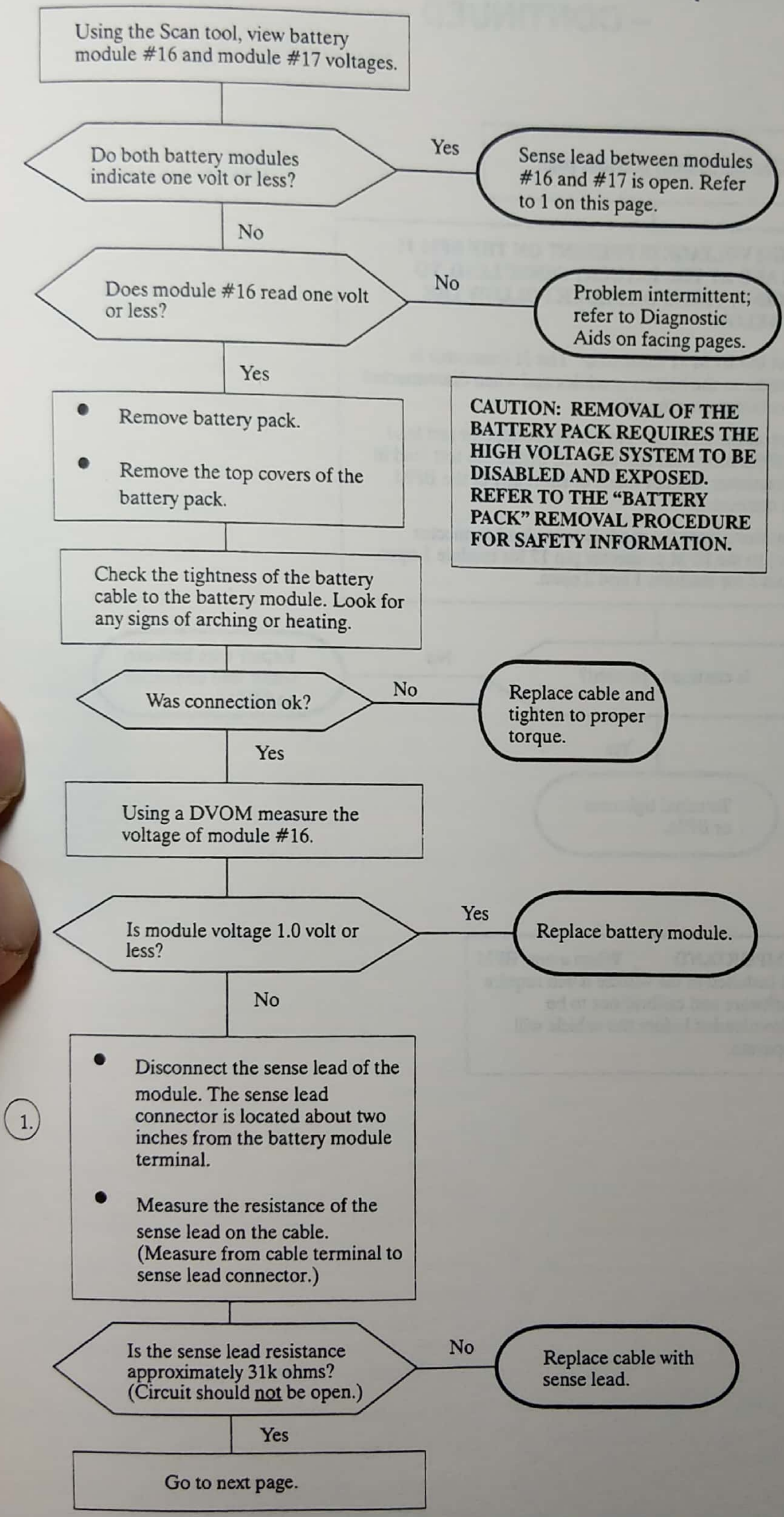
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

CS CamScanner

DTC 121

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #16)


Using the Scan tool, view battery module #16 and module #17 voltages.
Do both battery modules indicate one volt or less?
Yes
Sense lead between modules #16 and #17 is open. Refer to 1 on this page.
No
Does module #16 read one volt or less?
No
Problem intermittent; refer to Diagnostic Aids on facing pages.
Yes
Remove battery pack.
Remove the top covers of the battery pack.
Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.
Was connection ok?
No
Replace cable and tighten to proper torque.
Yes
Using a DVOM measure the voltage of module #16.
Is module voltage 1.0 volt or less?
Yes
Replace battery module.
No
1.
Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)
Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)
No
Replace cable with sense lead.
Yes
Go to next page.

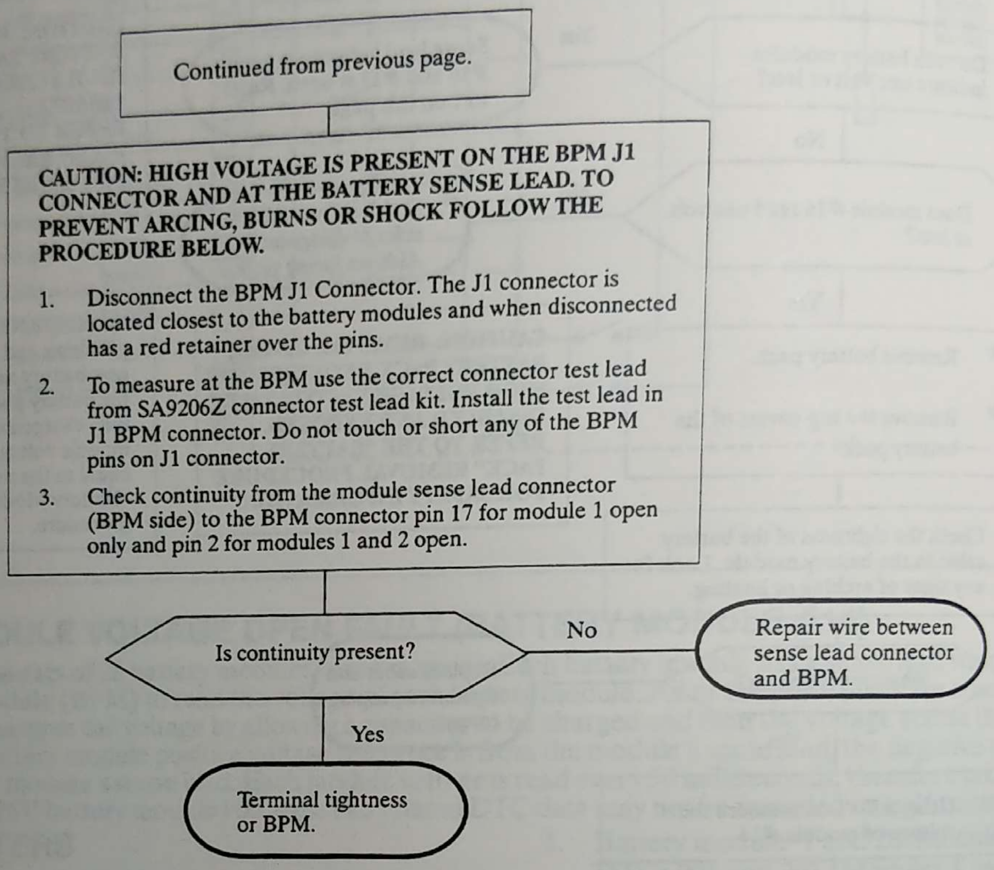
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 121

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #16) – CONTINUED



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CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

Is continuity present?

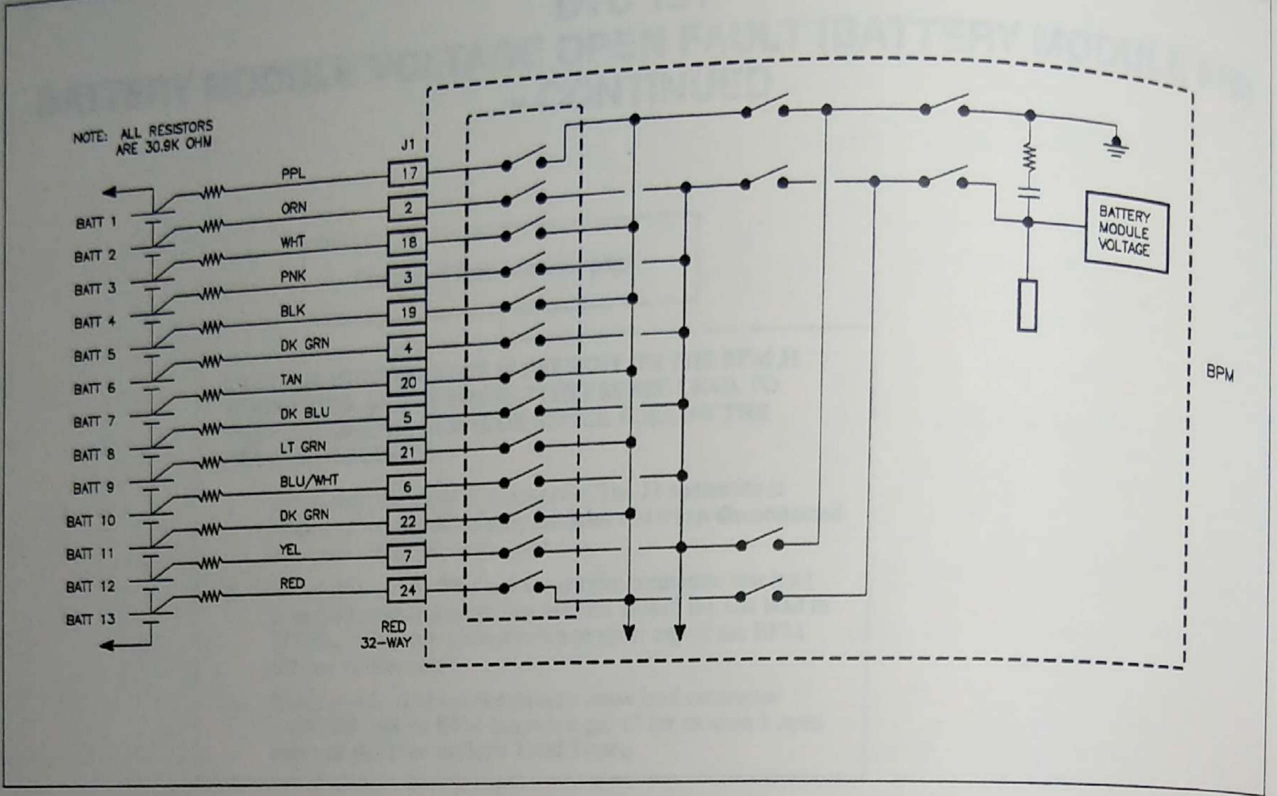
Repair wire between sense lead connector and BPM.

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 123 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #16)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #16: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

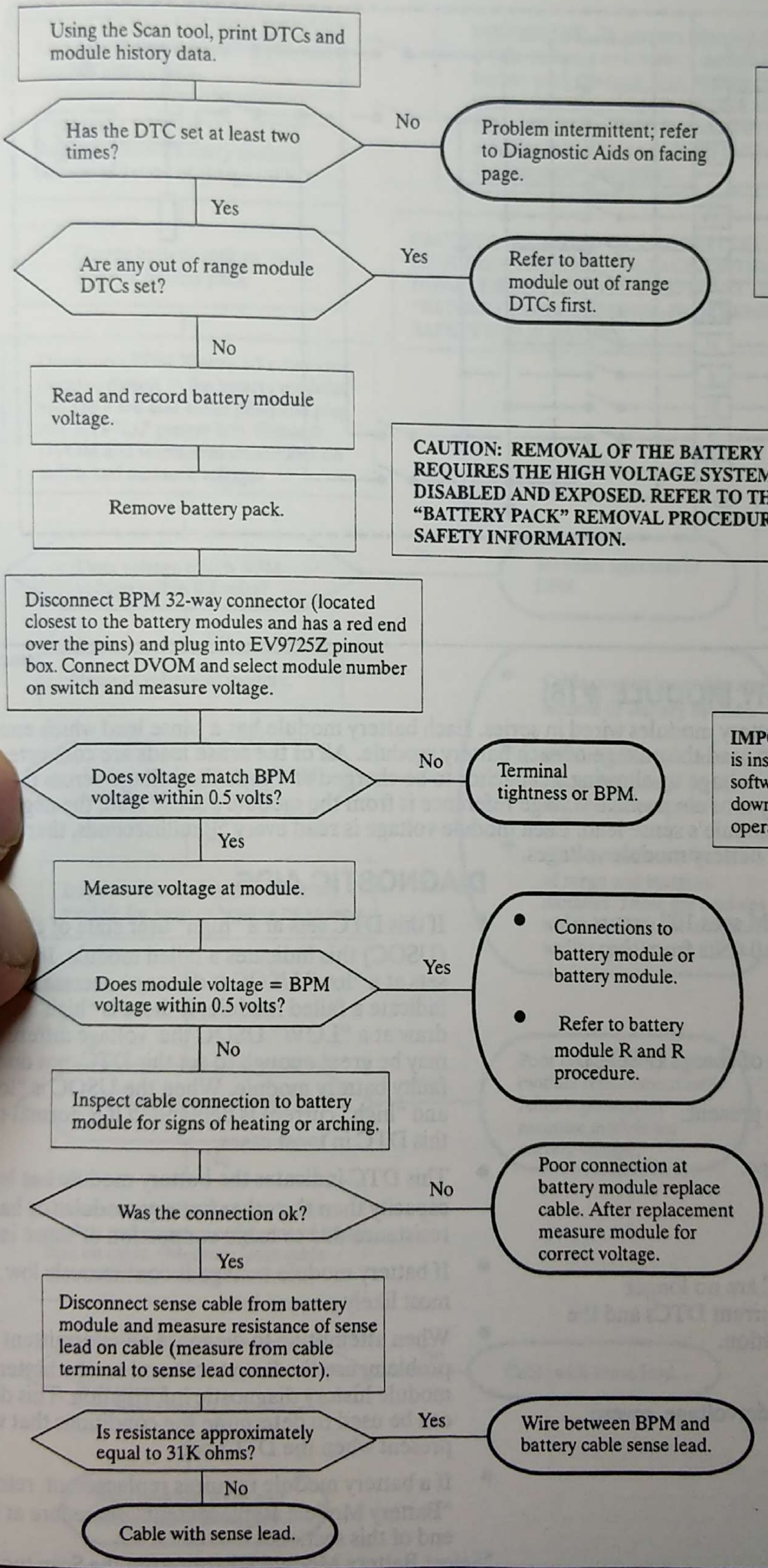
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section..
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

DTC 123
MARGINAL (BATTERY MODULE #16)

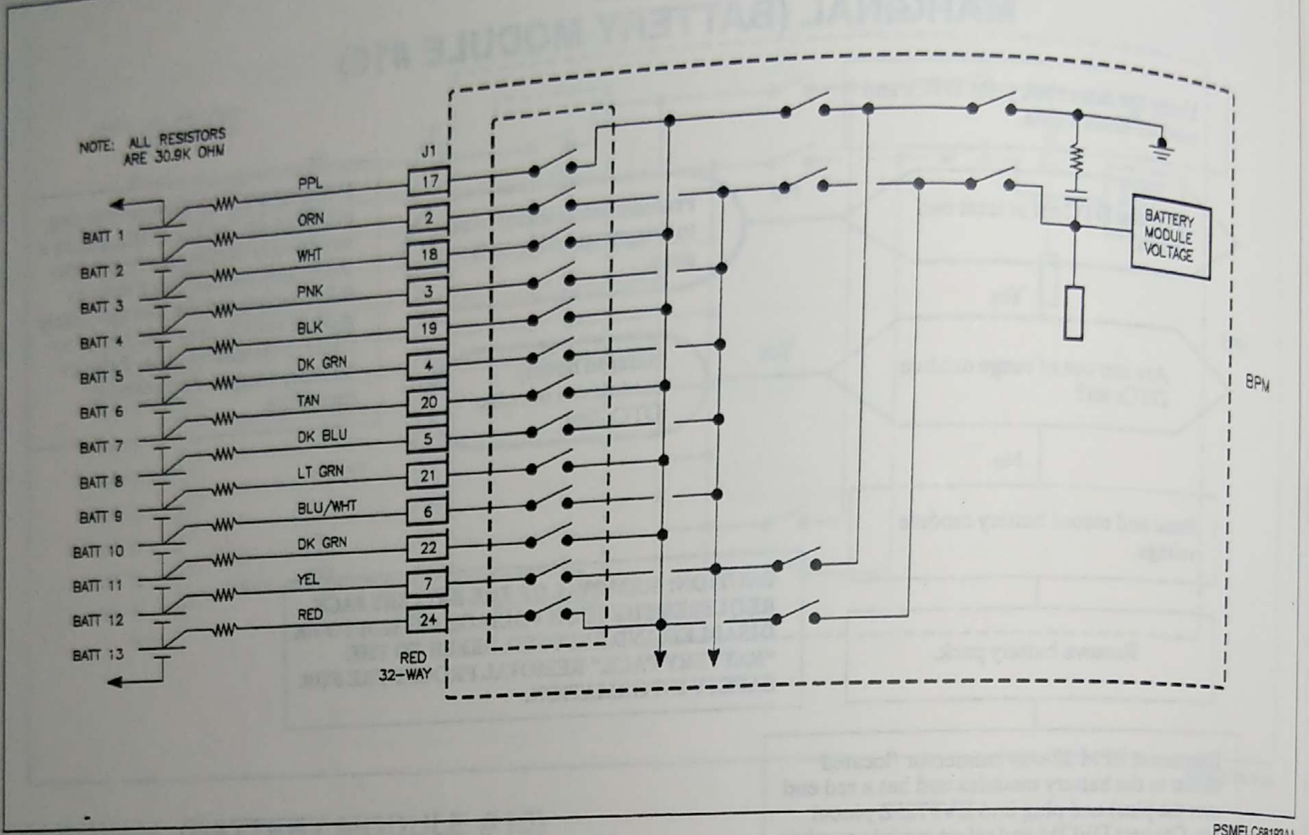

Using the Scan tool, print DTCs and module history data.
Has the DTC set at least two times?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any out of range module DTCs set?
Yes
Refer to battery module out of range DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Connections to battery module or battery module.
• Refer to battery module R and R procedure.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).
Is resistance approximately equal to 31K ohms?
Yes
Wire between BPM and battery cable sense lead.
No
Cable with sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 124 – OUT OF RANGE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
BATTERY MODULE VOLTAGE
BPM
PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #16)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #16: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

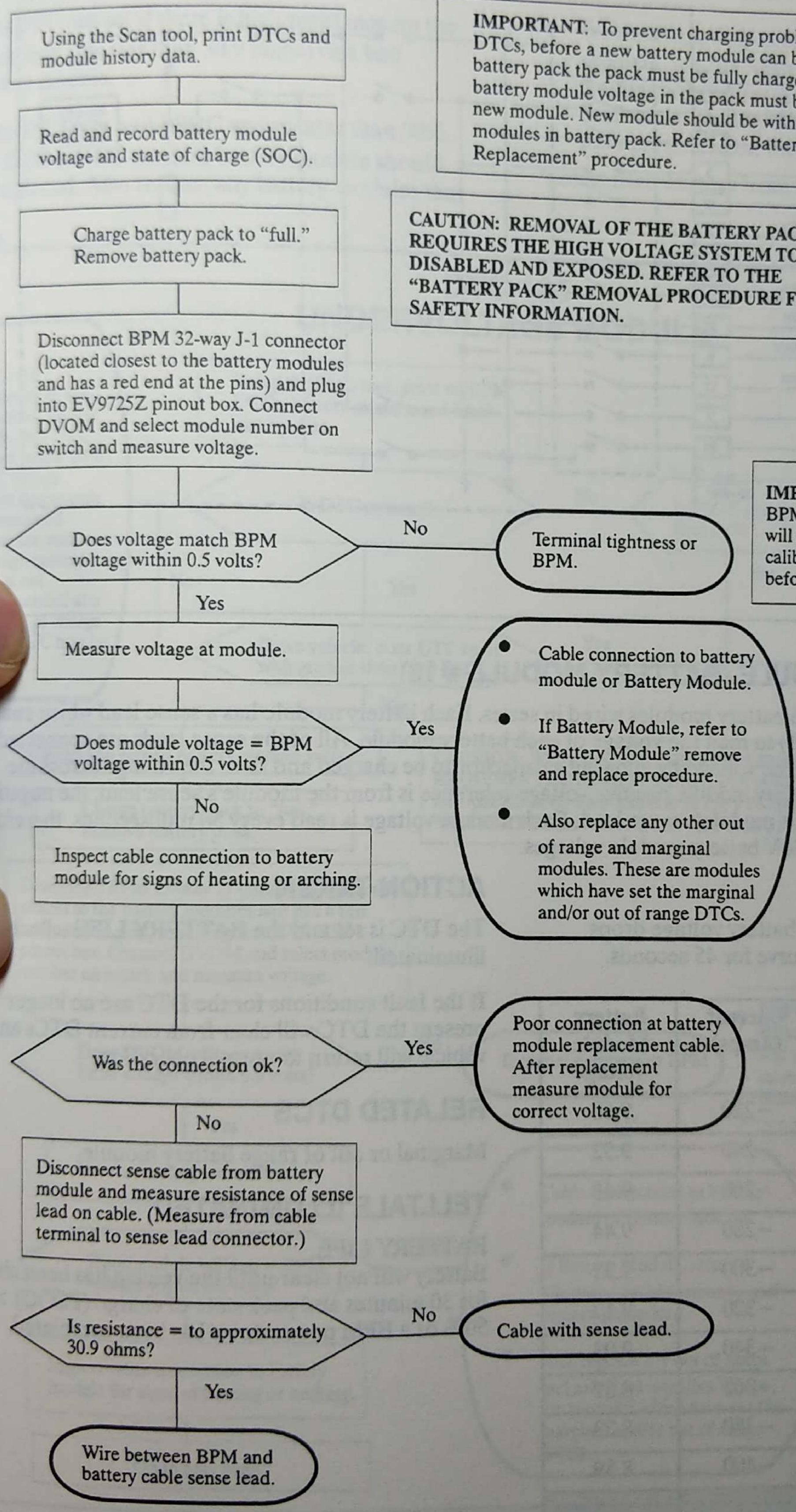
- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

*Select Battery Module History from the Scan tool BPM menu.

DTC 124
OUT OF RANGE (BATTERY MODULE #16)

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.



Using the Scan tool, print DTCs and module history data.

Read and record battery module voltage and state of charge (SOC).

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Cable connection to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Poor connection at battery module replacement cable. After replacement measure module for correct voltage.

Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)

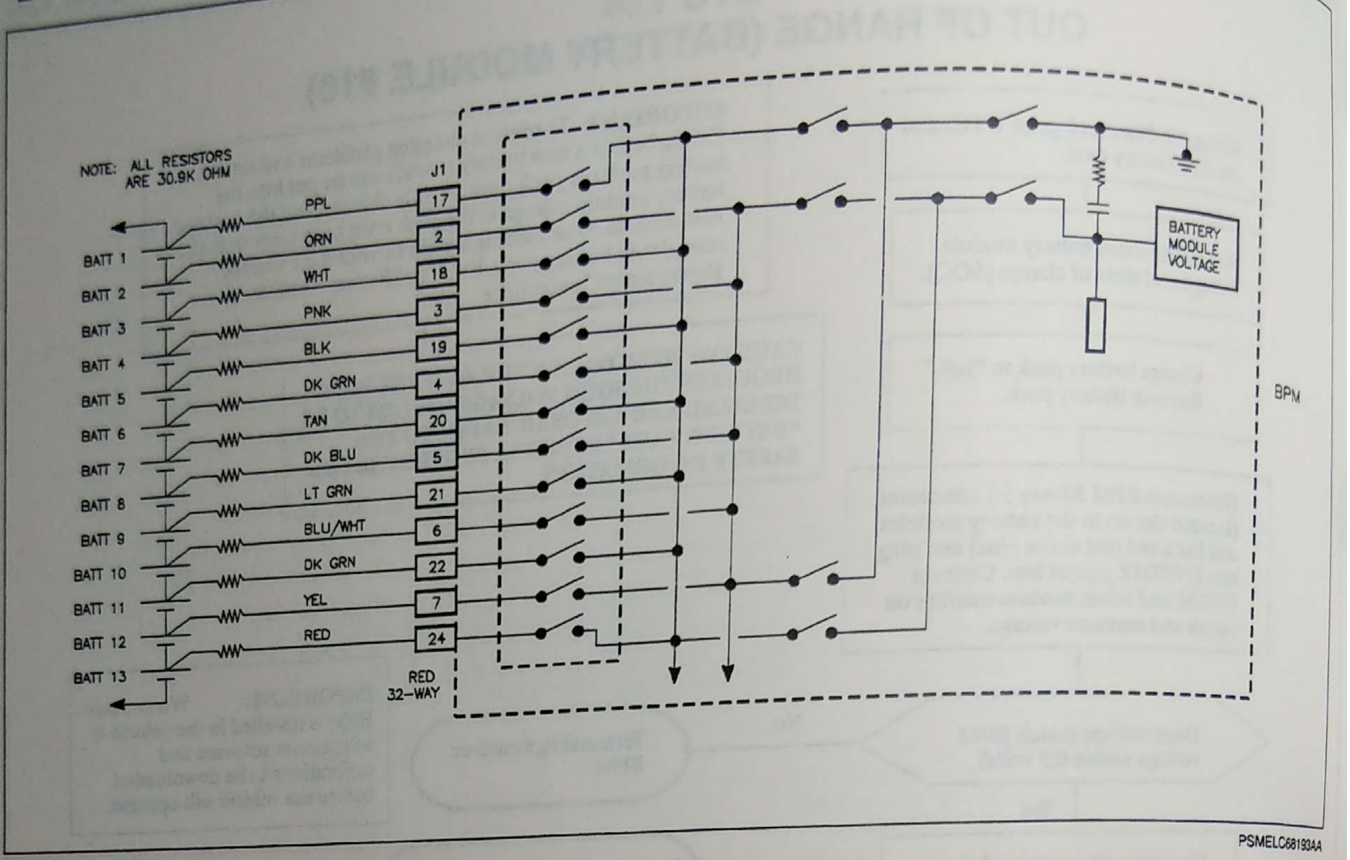
Is resistance = to approximately 30.9 ohms?

Cable with sense lead.

Wire between BPM and battery cable sense lead.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 125 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL 17
ORN 2
WHT 18
PNK 3
BLK 19
DK GRN 4
TAN 20
DK BLU 5
LT GRN 21
BLU/WHT 6
DK GRN 22
YEL 7
RED 24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #16)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage
0	11.75
−20	11.10
−40	10.90
−60	10.65
−80	10.45
−100	10.30
−120	10.15
−140	10.00
−160	9.90
−180	9.80
−200	9.70
−220	9.60
−240	9.52
−260	9.48
−280	9.44
−300	9.31
−320	9.17
−340	9.03
−360	8.87
−380	8.73
−400	8.59

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

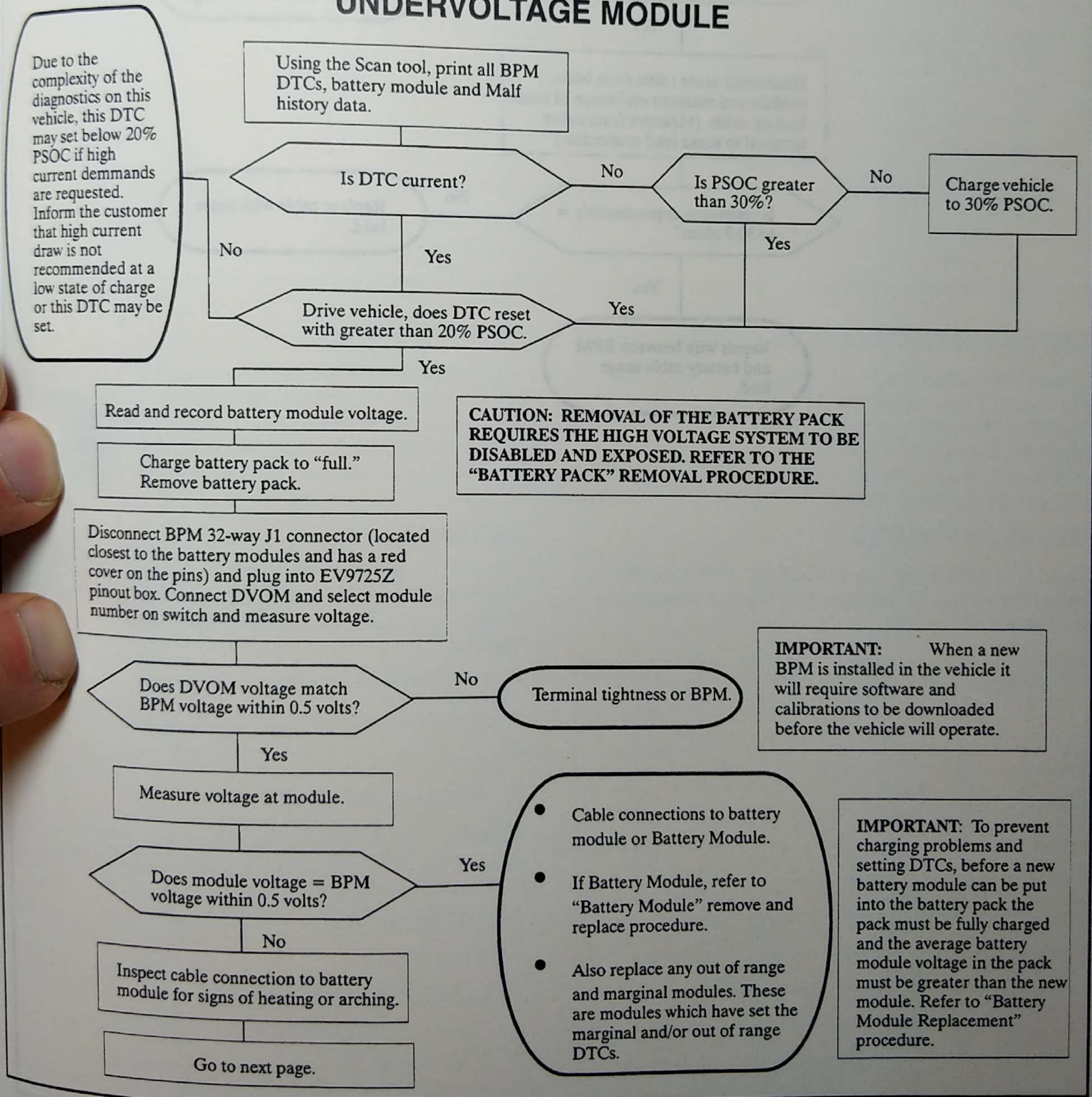
BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below zero percent user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 125
UNDERVOLTAGE MODULE



Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

Using the Scan tool, print all BPM DTCs, battery module and Malf history data.

Is DTC current?

Is PSOC greater than 30%?

Charge vehicle to 30% PSOC.

Drive vehicle, does DTC reset with greater than 20% PSOC.

Read and record battery module voltage.

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

Inspect cable connection to battery module for signs of heating or arching.

Go to next page.

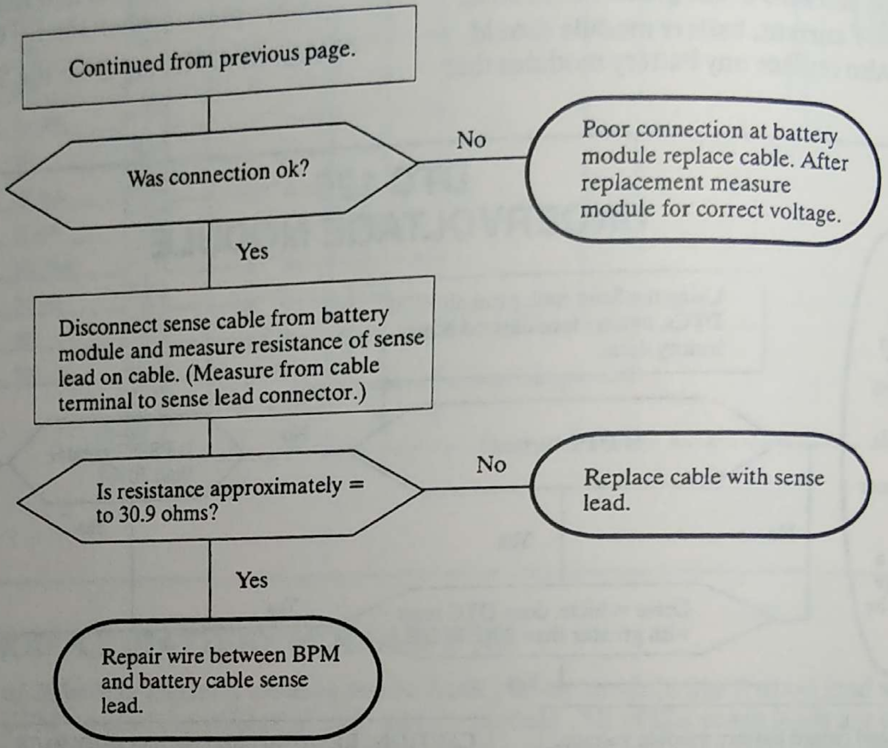
- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

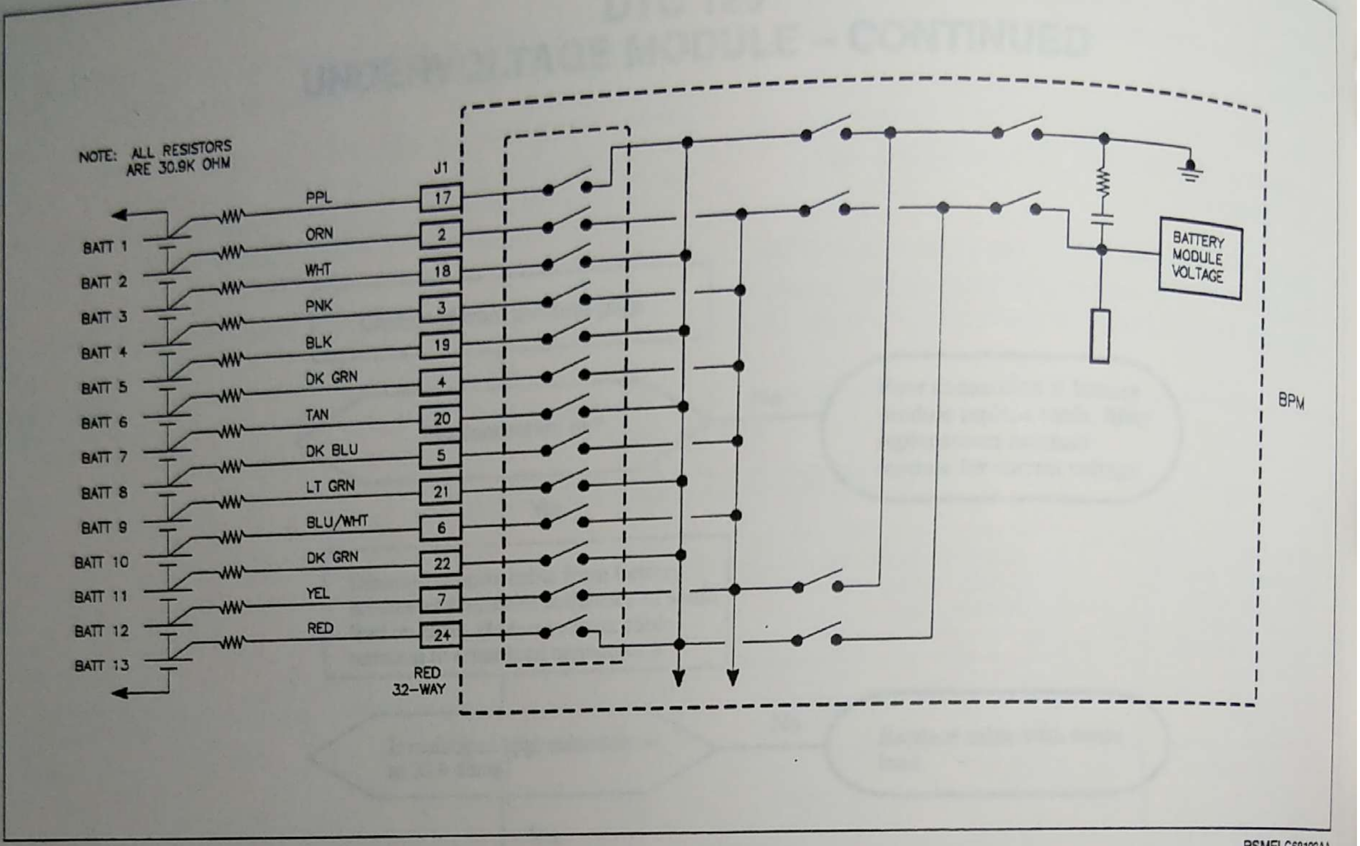
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 125
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 126 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #16)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

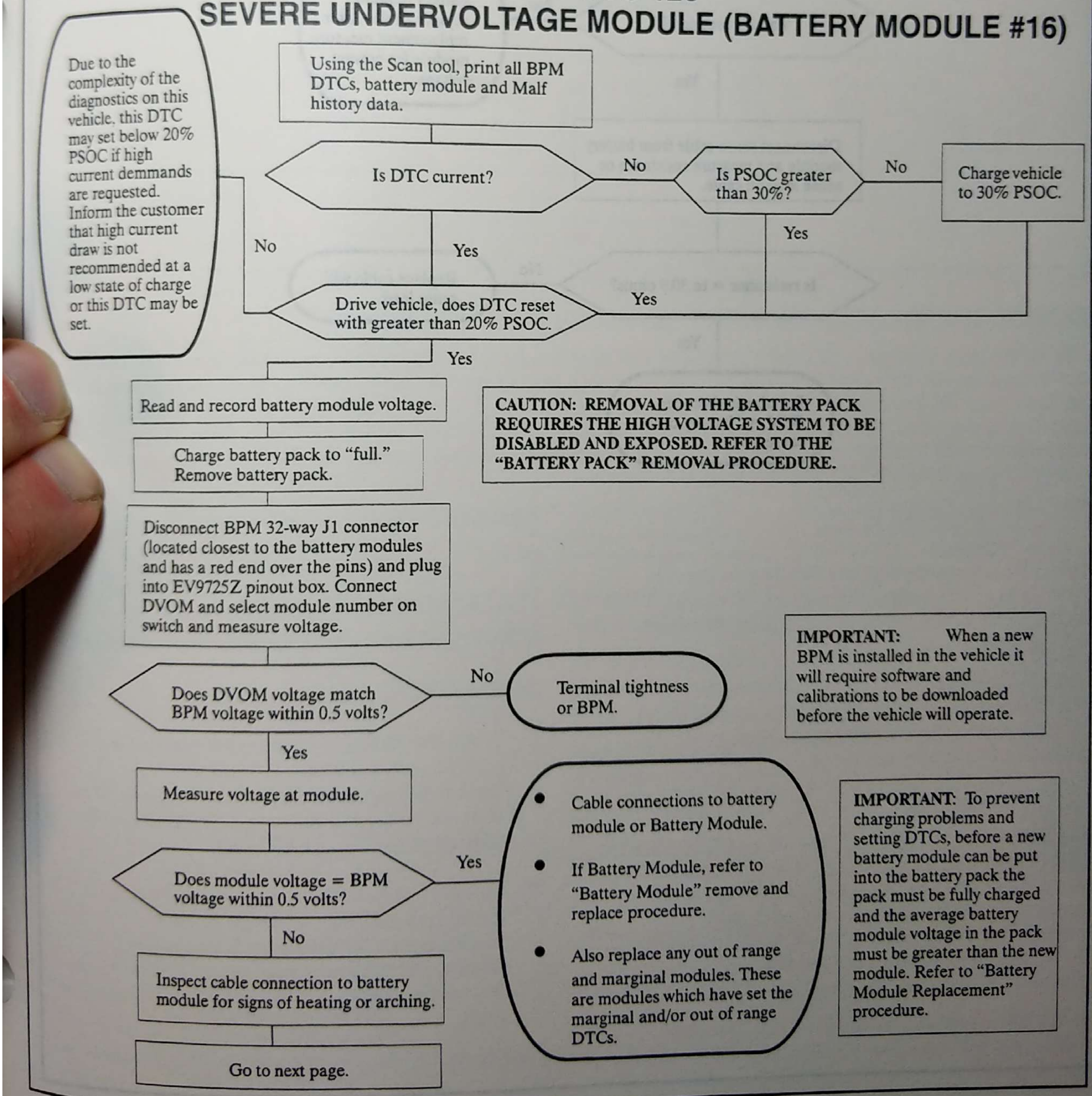
DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches zero percent user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

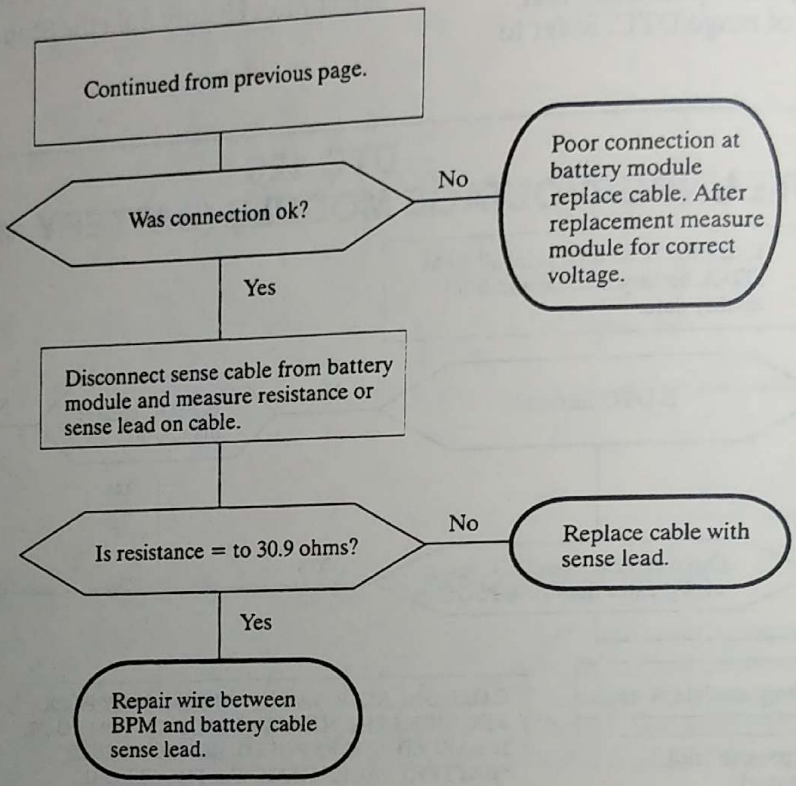
DTC 126

DTC 126
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #16)


Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

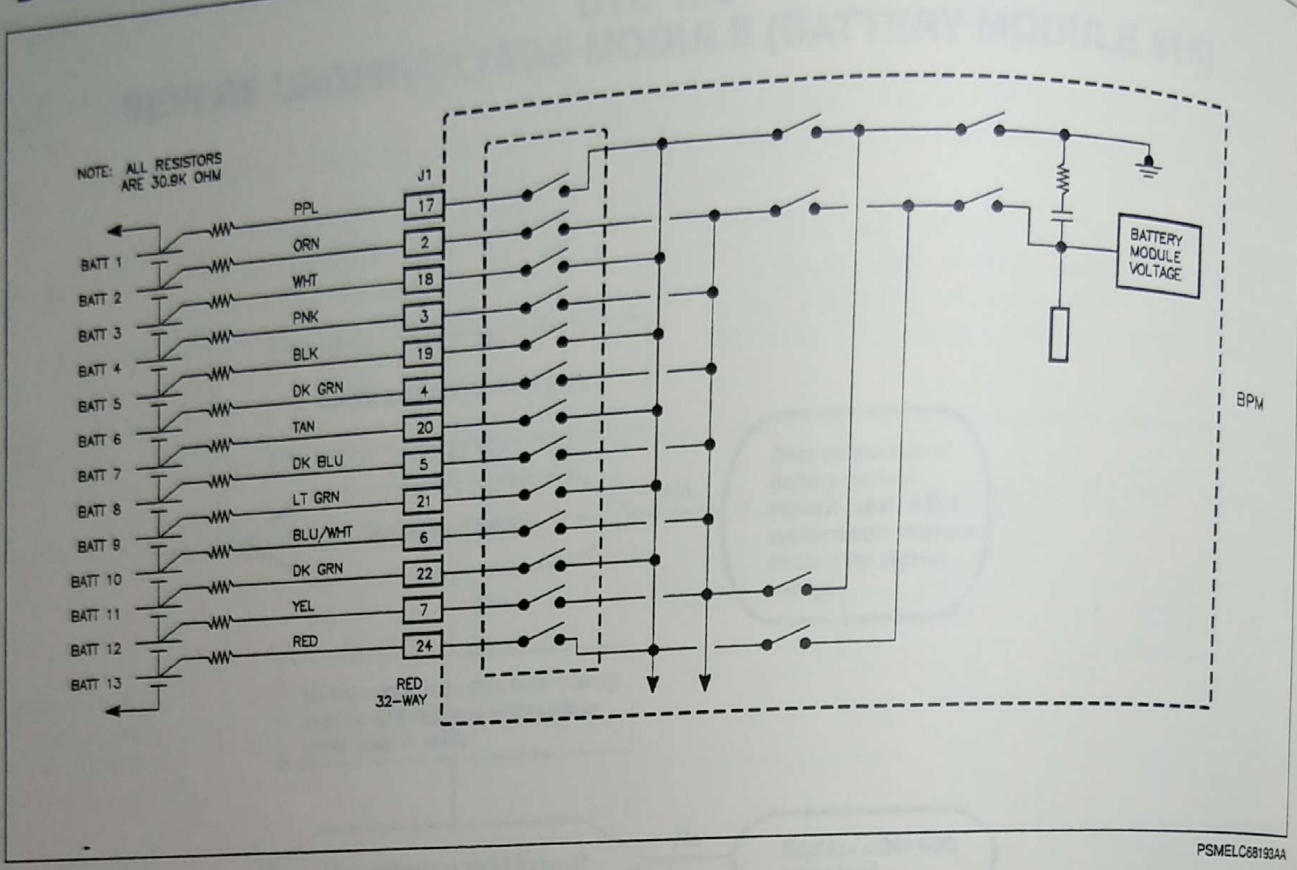
DTC 126

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #16)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 127 – SEVERE OVERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
PPL
17
ORN
2
WHT
18
PNK
3
BLK
19
DK GRN
4
TAN
20
DK BLU
5
LT GRN
21
BLU/WHT
6
DK GRN
22
YEL
7
RED
24
RED 32–WAY
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
BATTERY MODULE VOLTAGE
BPM
PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #16)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

SERVICE NOW and REDUCED PERFORMANCE

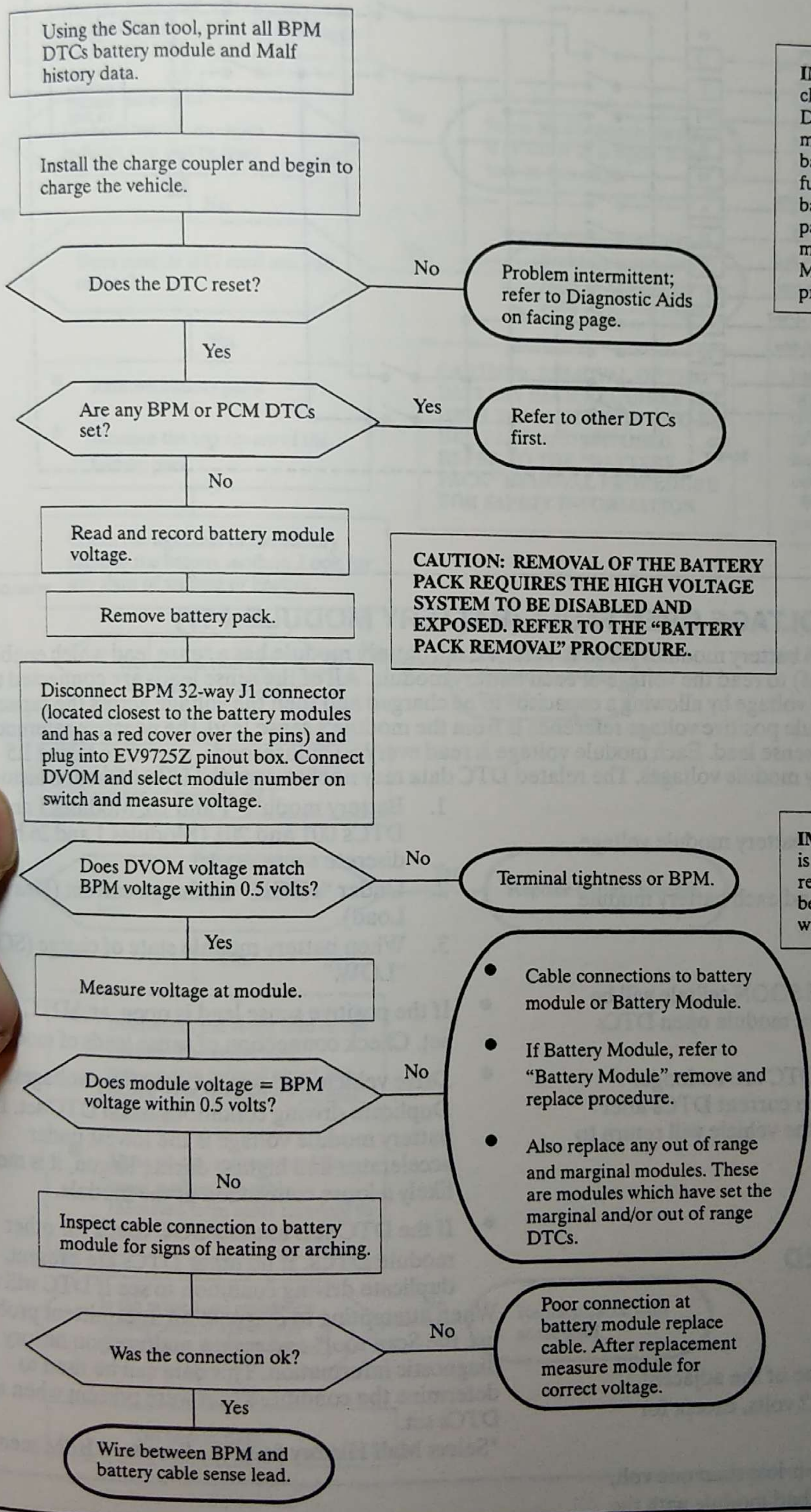
DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

DTC 127

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #16)

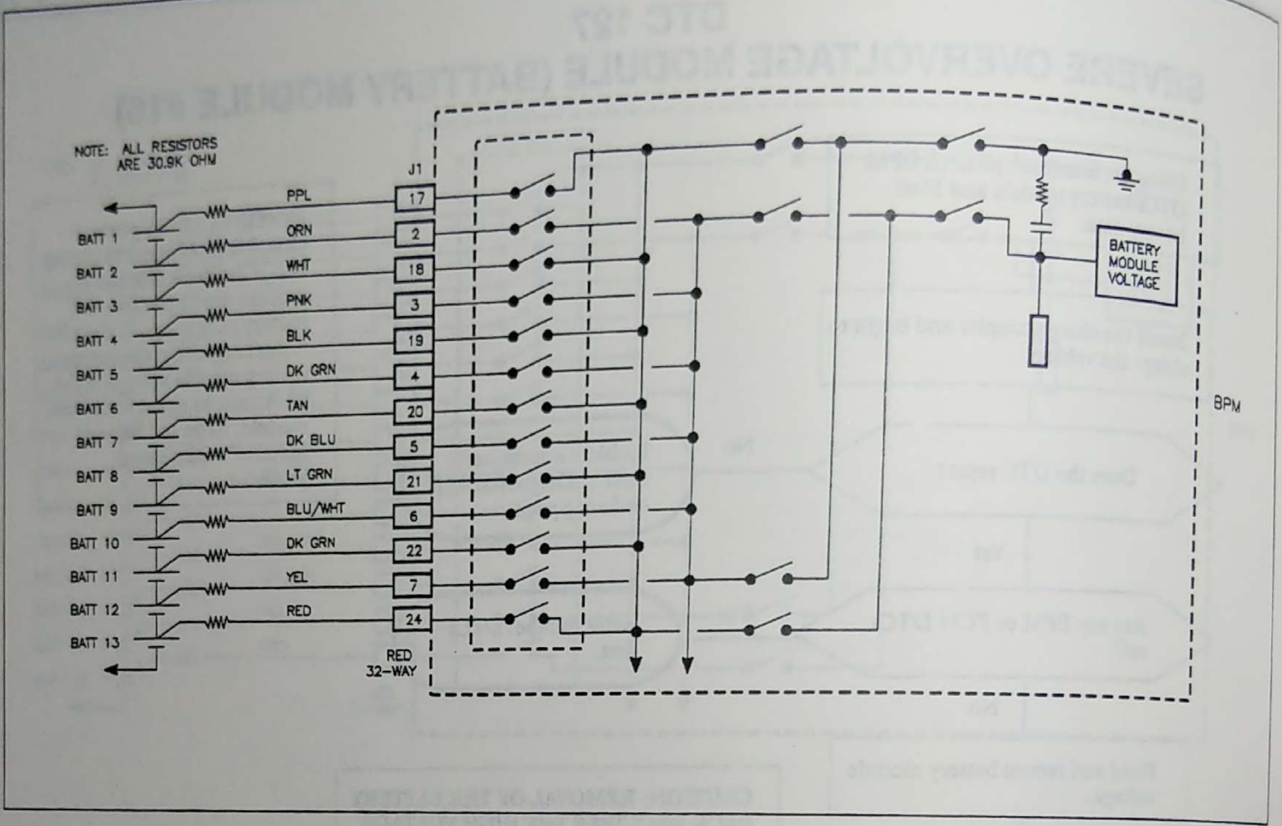

Using the Scan tool, print all BPM DTCs battery module and Malf history data.
Install the charge coupler and begin to charge the vehicle.
Does the DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any BPM or PCM DTCs set?
Yes
Refer to other DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
No
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Wire between BPM and battery cable sense lead.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 129 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #17)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

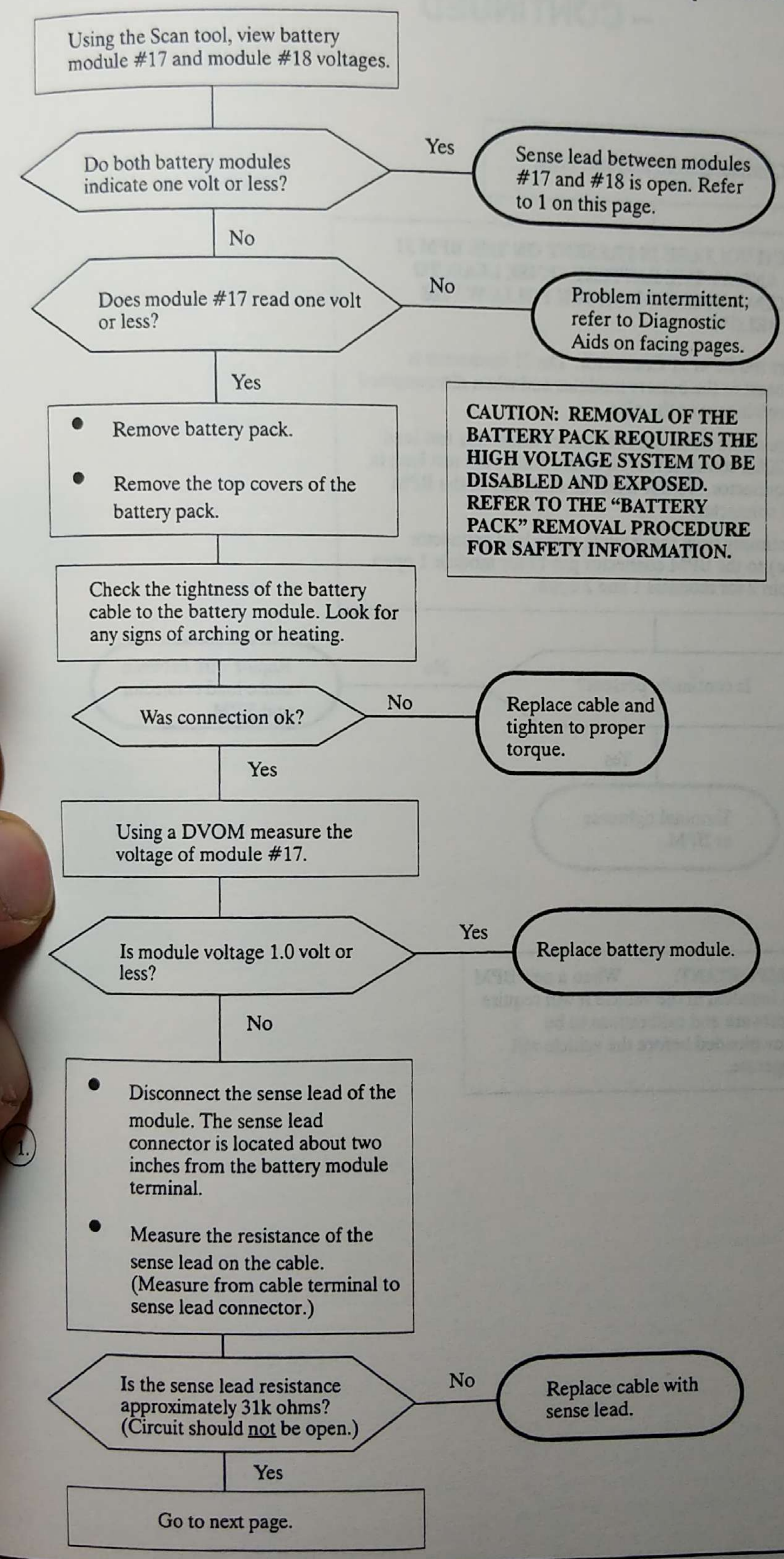
- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:
  1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
  2. Under "HIGH" discharge current (Heavy Load).
  3. When battery module state of charge (SOC) is "LOW."
- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 129

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #17)


Using the Scan tool, view battery module #17 and module #18 voltages.
Do both battery modules indicate one volt or less?
Yes
Sense lead between modules #17 and #18 is open. Refer to 1 on this page.
No
Does module #17 read one volt or less?
No
Problem intermittent; refer to Diagnostic Aids on facing pages.
Yes
Remove battery pack.
Remove the top covers of the battery pack.
Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.
Was connection ok?
No
Replace cable and tighten to proper torque.
Yes
Using a DVOM measure the voltage of module #17.
Is module voltage 1.0 volt or less?
Yes
Replace battery module.
No
1.
Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)
Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)
No
Replace cable with sense lead.
Yes
Go to next page.

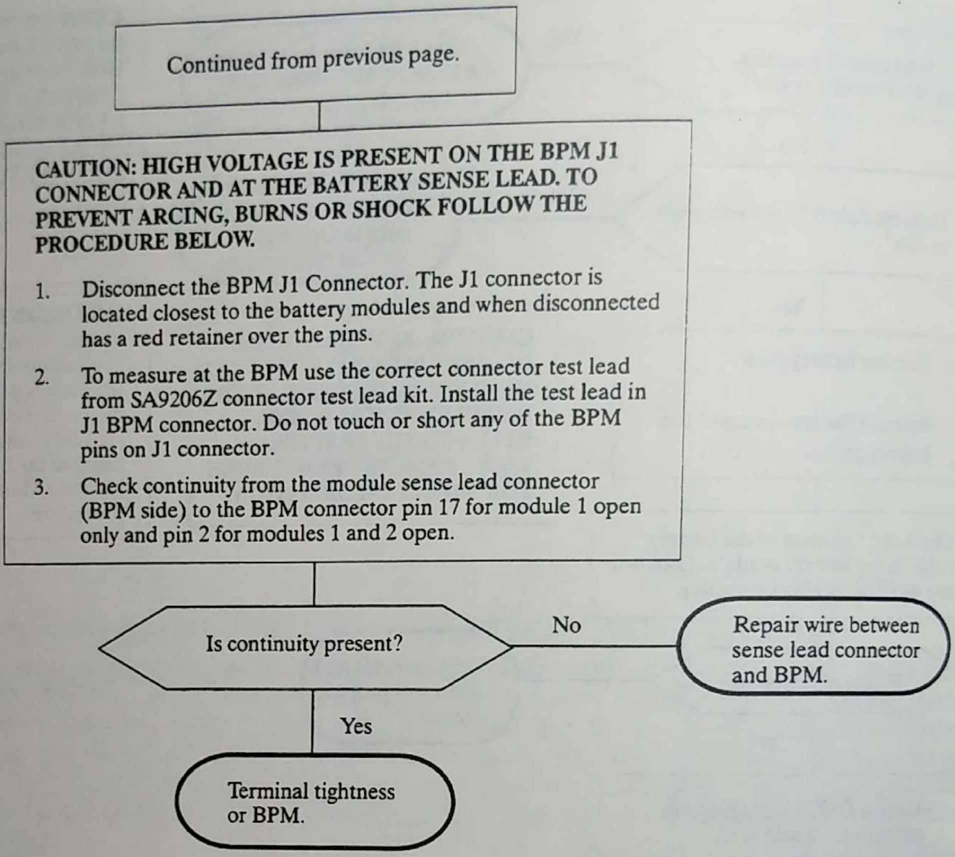
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 129

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #17) – CONTINUED



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CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

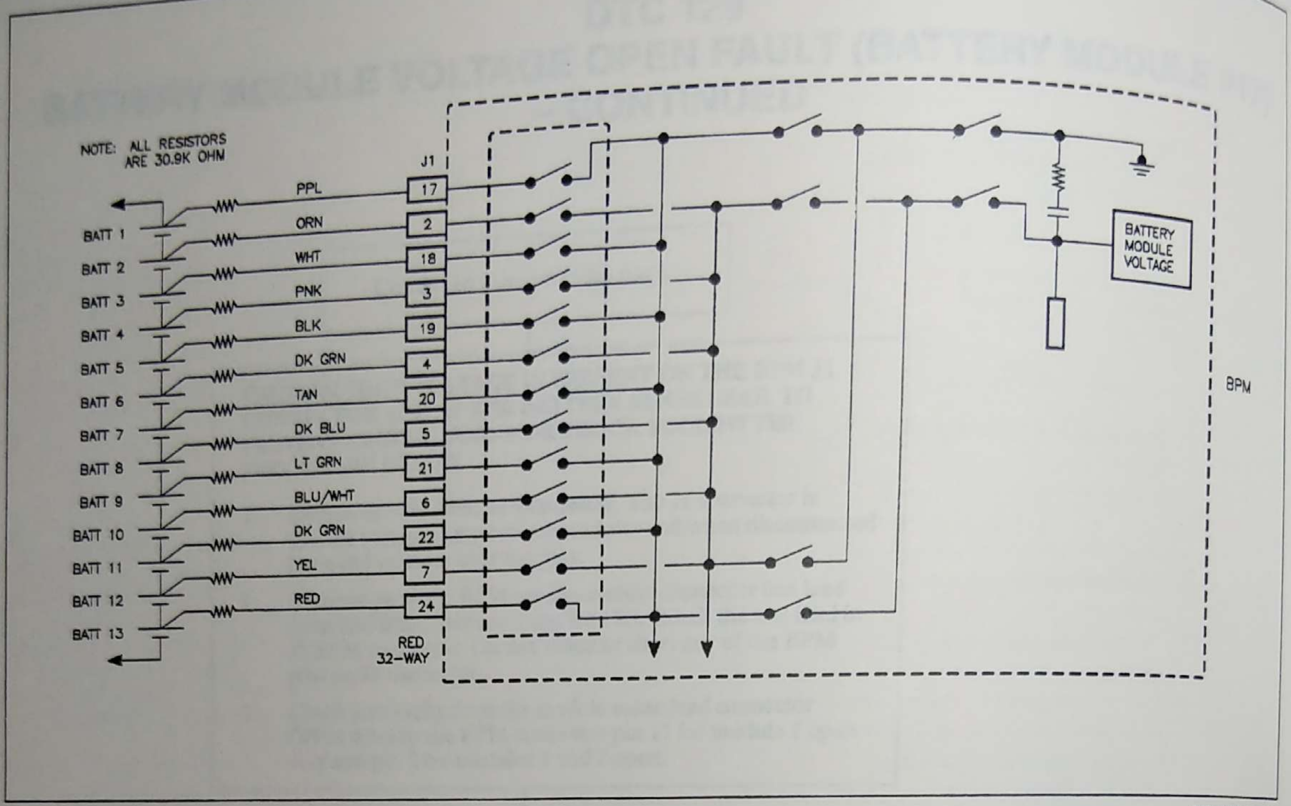
1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

Is continuity present?
No
Repair wire between sense lead connector and BPM.
Yes
Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 131 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #17)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #17: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

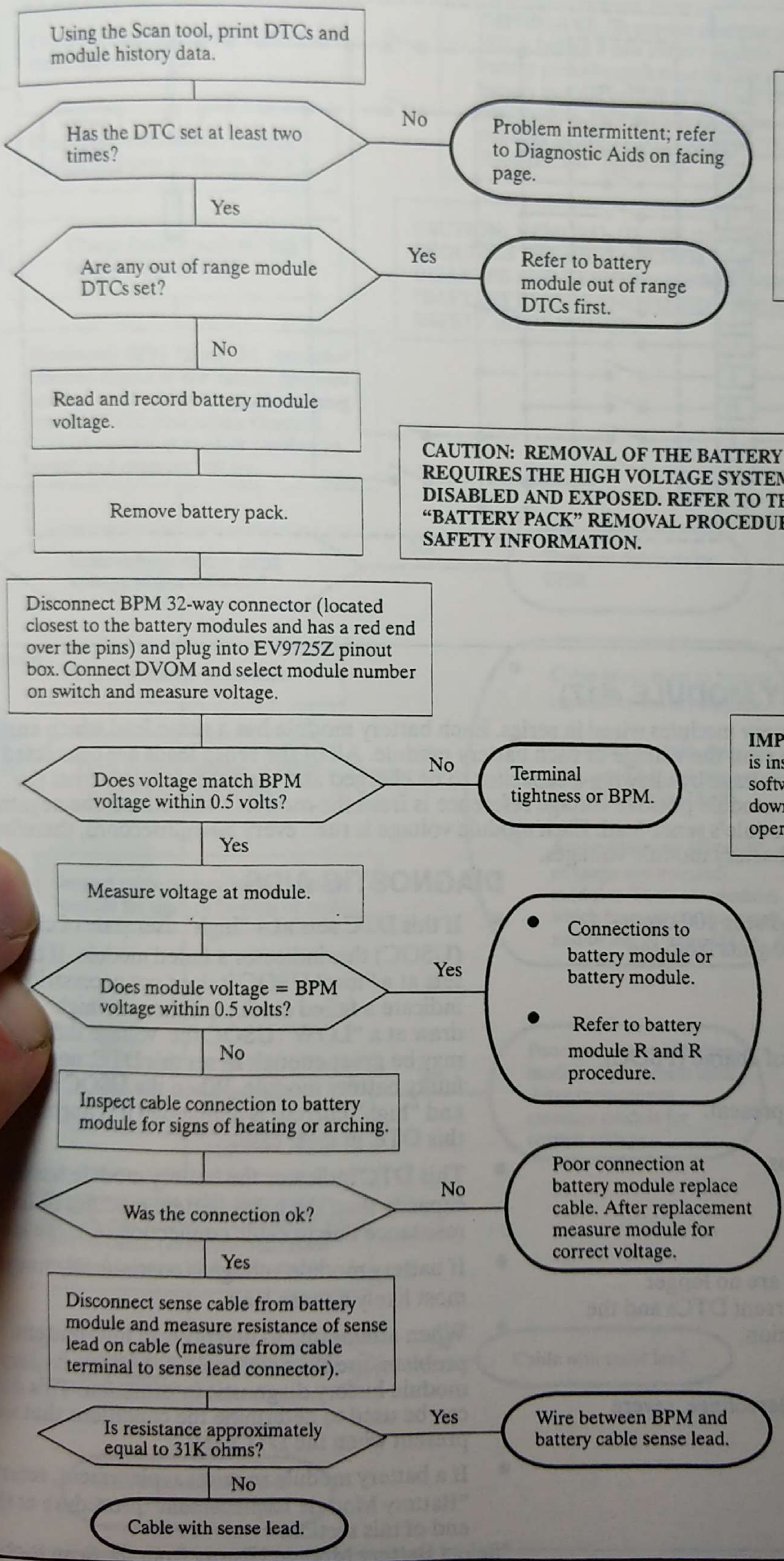
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

DTC 131
MARGINAL (BATTERY MODULE #17)

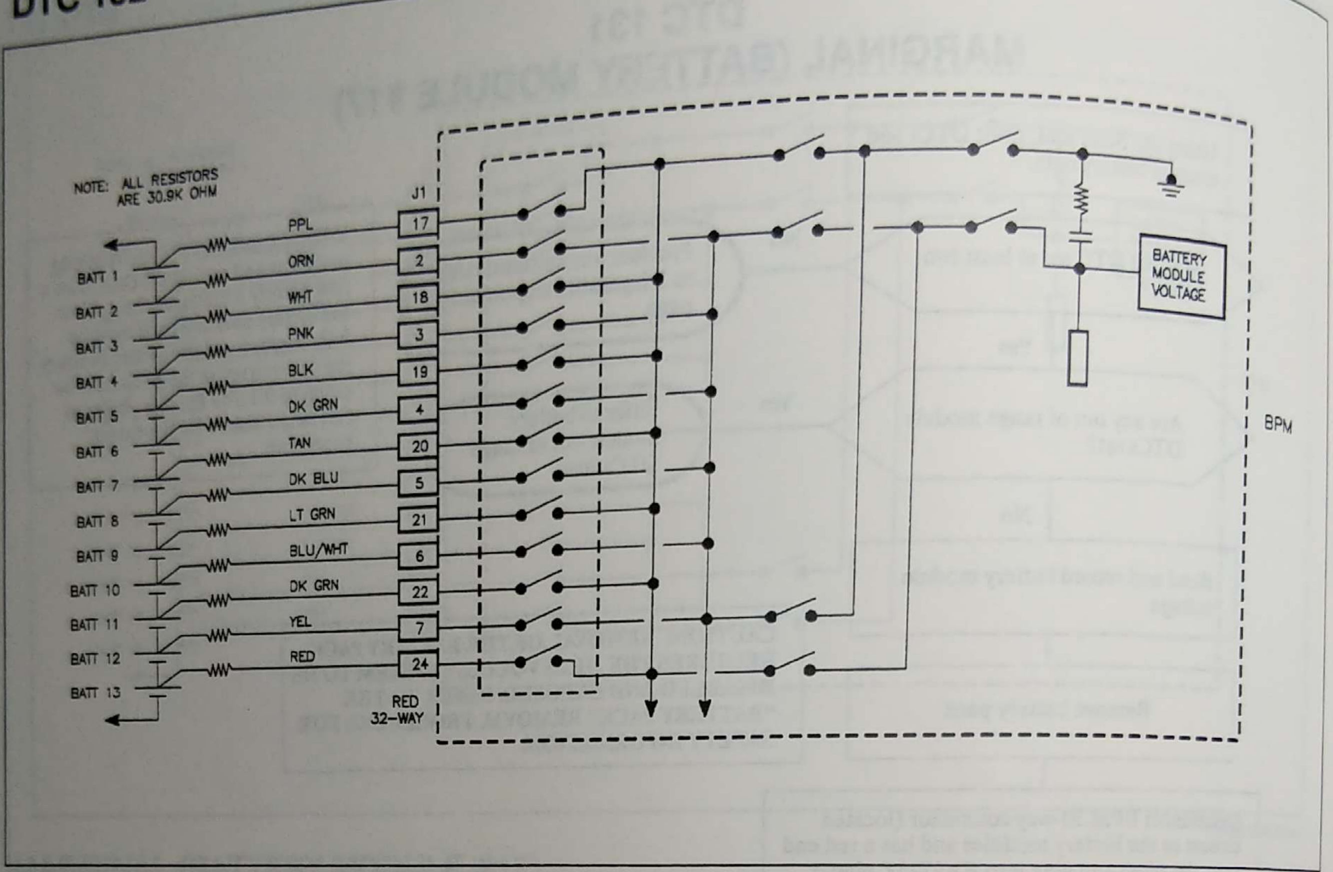

Using the Scan tool, print DTCs and module history data.
Has the DTC set at least two times?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any out of range module DTCs set?
Yes
Refer to battery module out of range DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Connections to battery module or battery module.
• Refer to battery module R and R procedure.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).
Is resistance approximately equal to 31K ohms?
Yes
Wire between BPM and battery cable sense lead.
No
Cable with sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 132 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #17)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #17: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

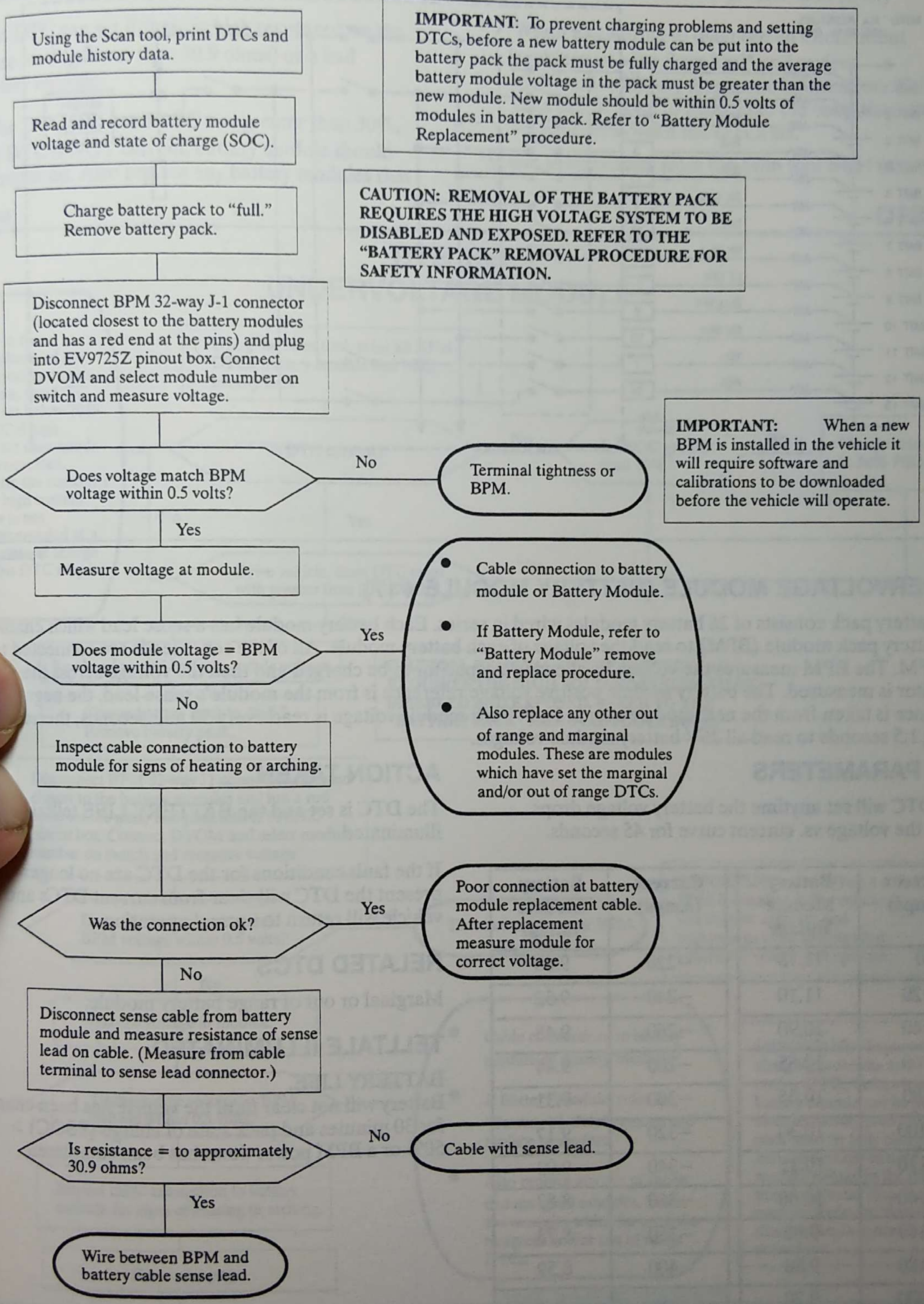
None

DIAGNOSTIC AIDS

- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

*Select Battery Module History from the Scan tool BPM menu.

DTC 132
OUT OF RANGE (BATTERY MODULE #17)



Using the Scan tool, print DTCs and module history data.

Read and record battery module voltage and state of charge (SOC).

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?
- No: Terminal tightness or BPM.
- Yes: Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?
- Yes:
  - Cable connection to battery module or Battery Module.
  - If Battery Module, refer to "Battery Module" remove and replace procedure.
  - Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
- No: Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?
- Yes: Poor connection at battery module replacement cable. After replacement measure module for correct voltage.
- No: Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)

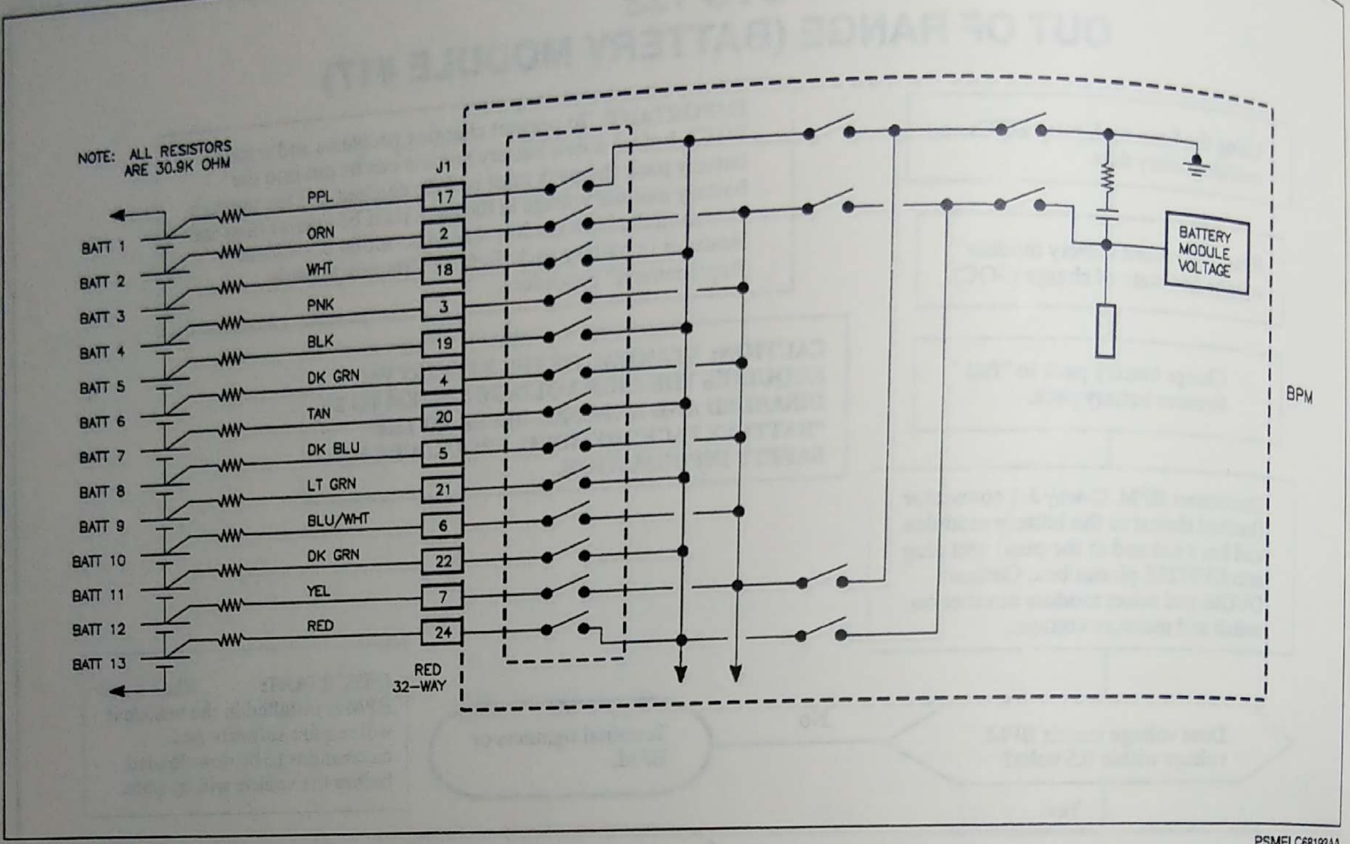
Is resistance = to approximately 30.9 ohms?
- No: Cable with sense lead.
- Yes: Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 133 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #17)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage
0	11.75
−20	11.10
−40	10.90
−60	10.65
−80	10.45
−100	10.30
−120	10.15
−140	10.00
−160	9.90
−180	9.80
−200	9.70
−220	9.60
−240	9.52
−260	9.48
−280	9.44
−300	9.31
−320	9.17
−340	9.03
−360	8.87
−380	8.73
−400	8.59

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

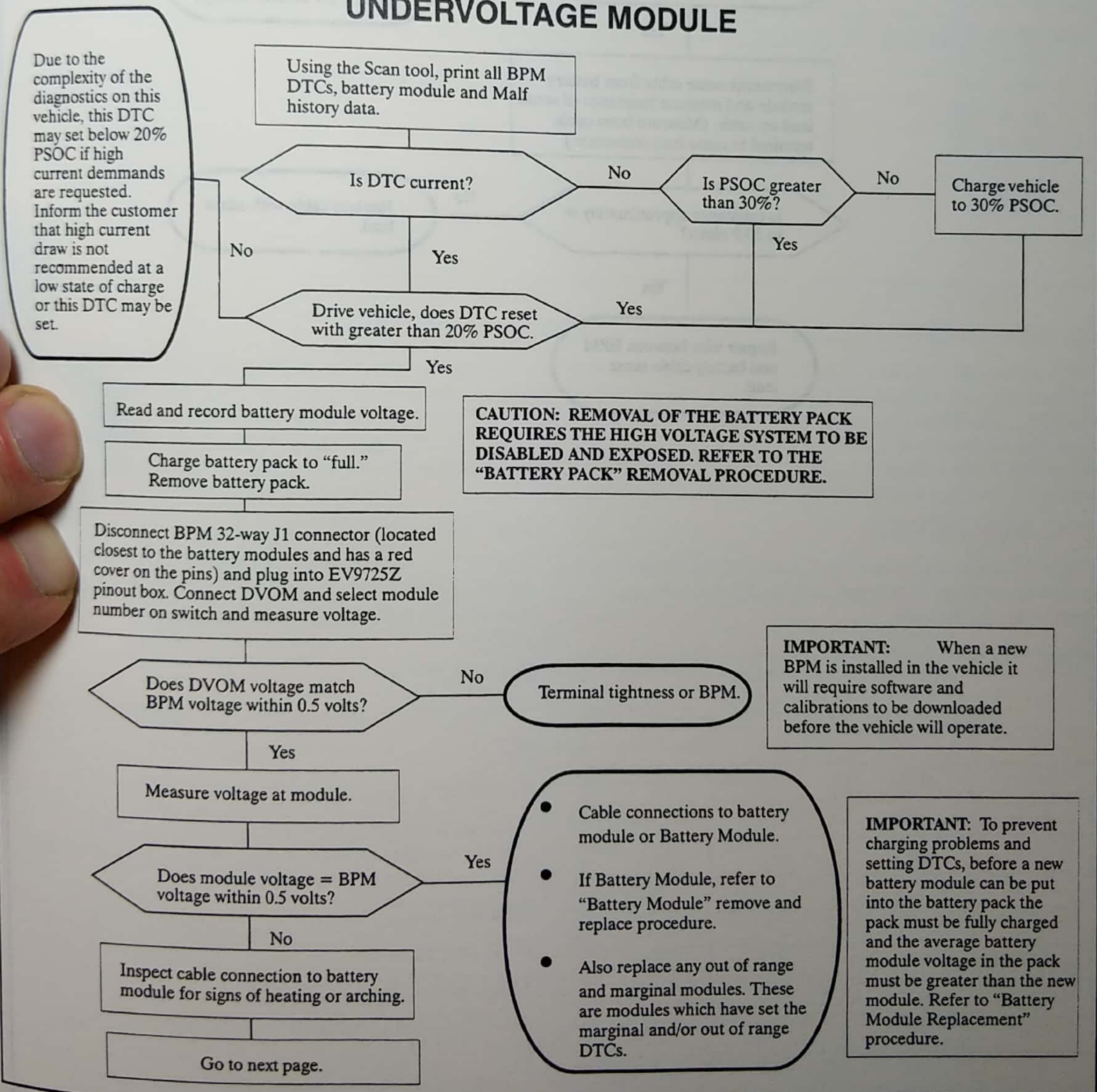
BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below zero percent user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 133
UNDERVOLTAGE MODULE

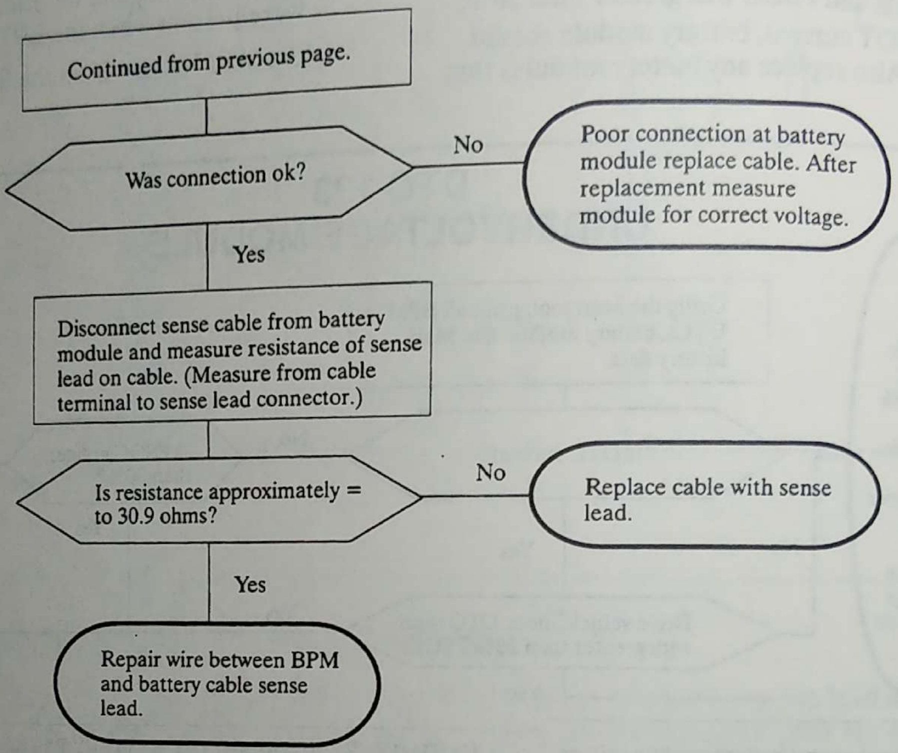

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

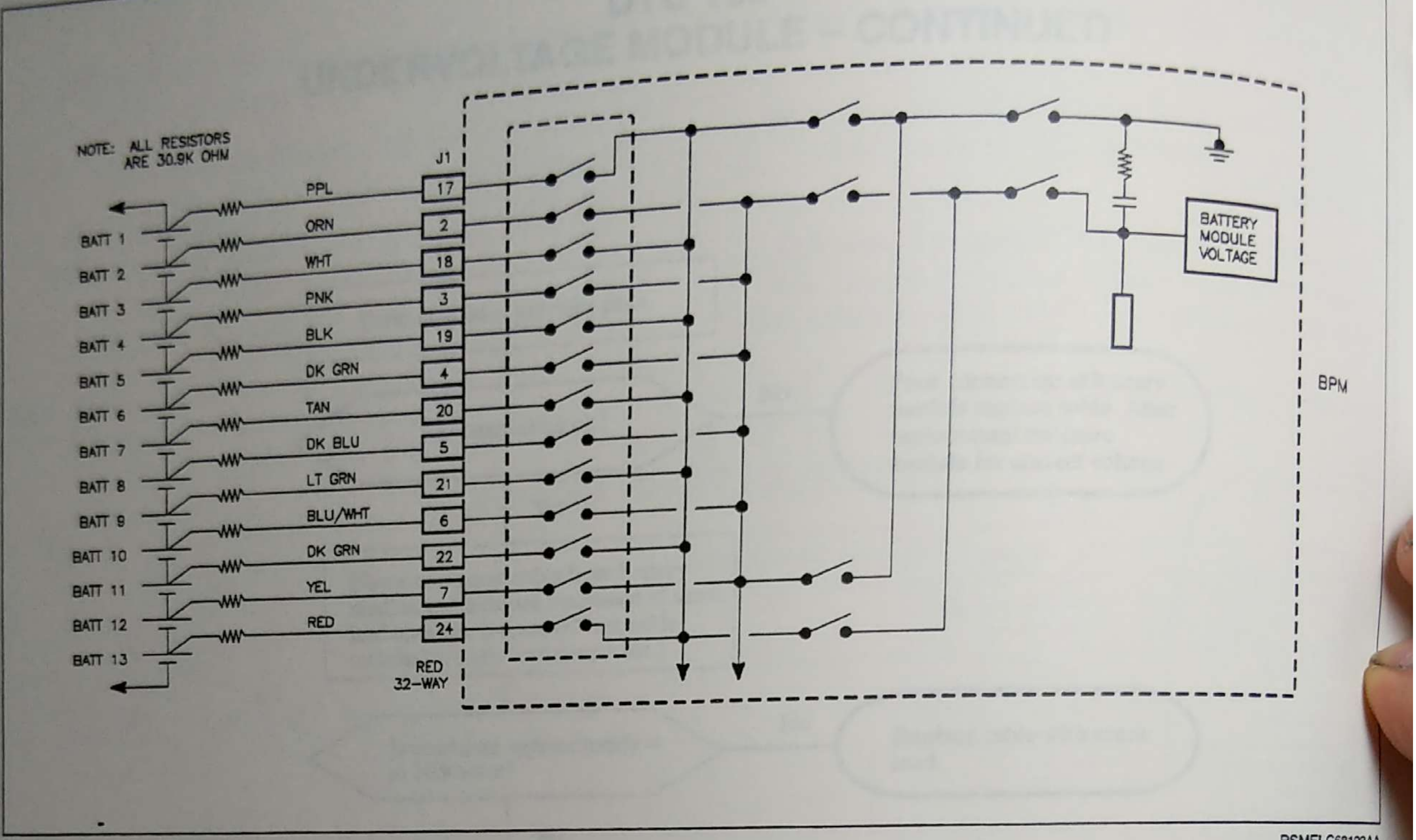
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 133
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 134 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #17)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

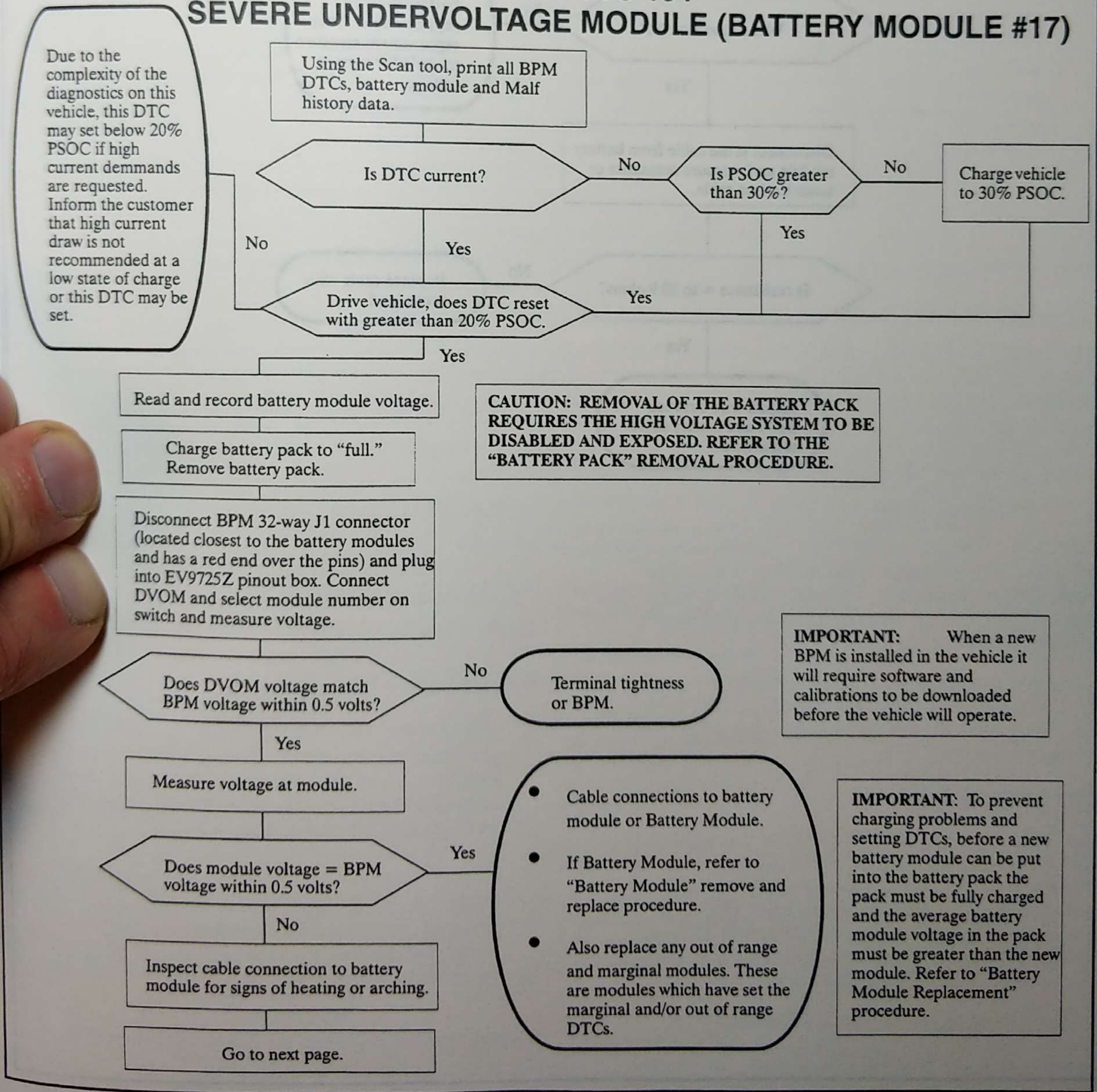
Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches zero percent user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 134
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #17)



Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

Using the Scan tool, print all BPM DTCs, battery module and Malf history data.

Is DTC current?

Is PSOC greater than 30%?

Charge vehicle to 30% PSOC.

Drive vehicle, does DTC reset with greater than 20% PSOC.

Read and record battery module voltage.

Charge battery pack to "full." Remove battery pack.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

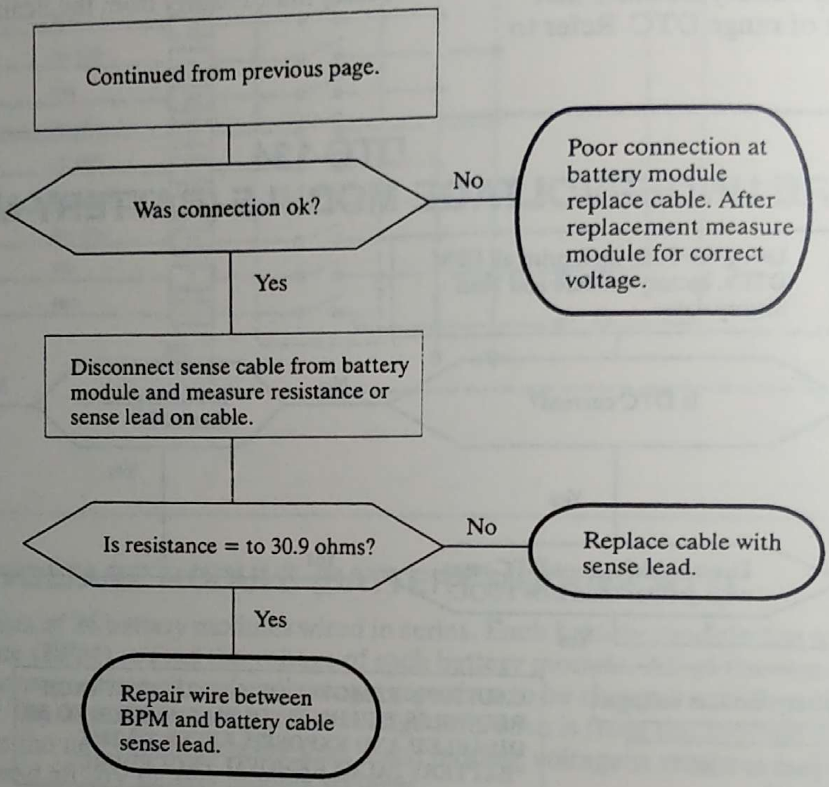
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

Inspect cable connection to battery module for signs of heating or arching.

Go to next page.

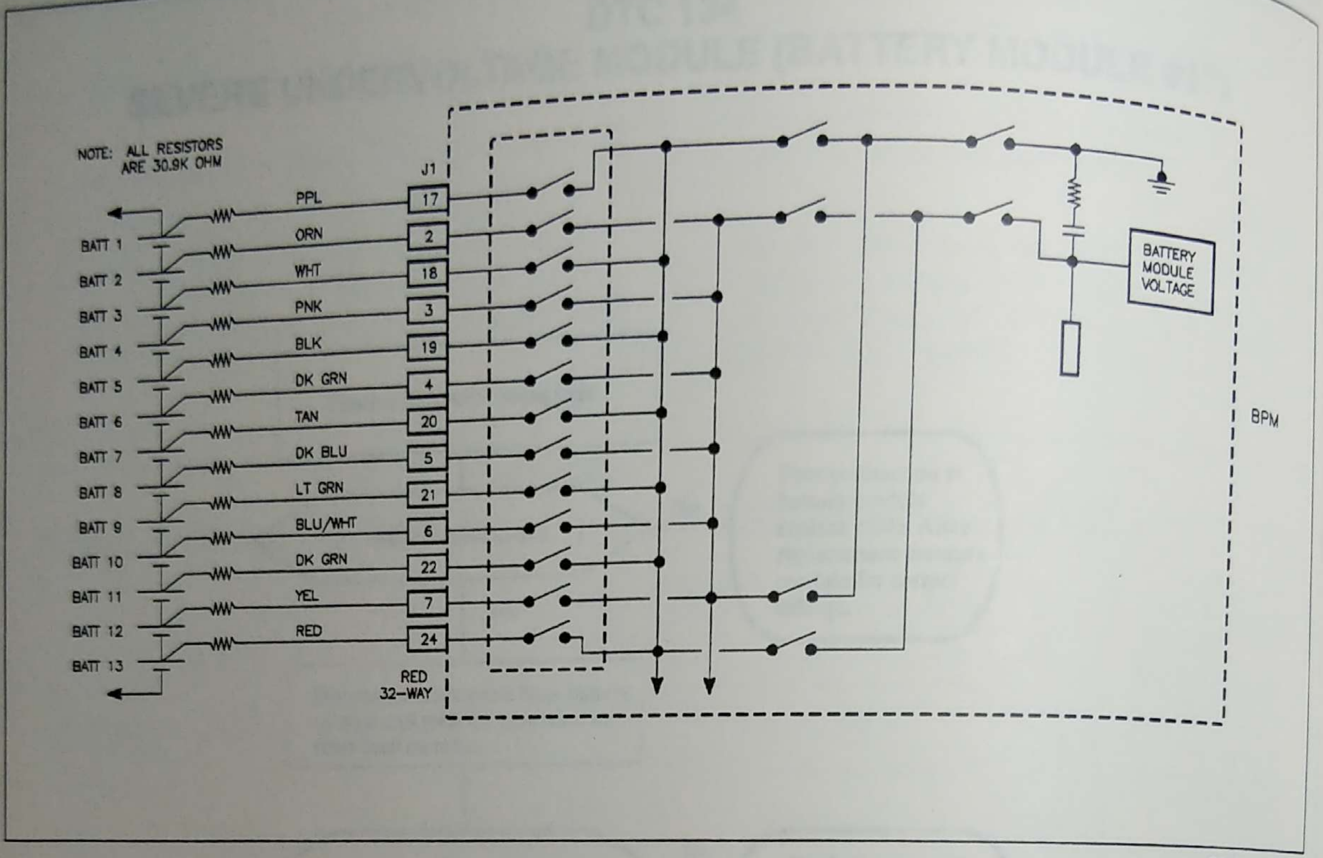
DTC 134

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #17)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 135 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #17)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

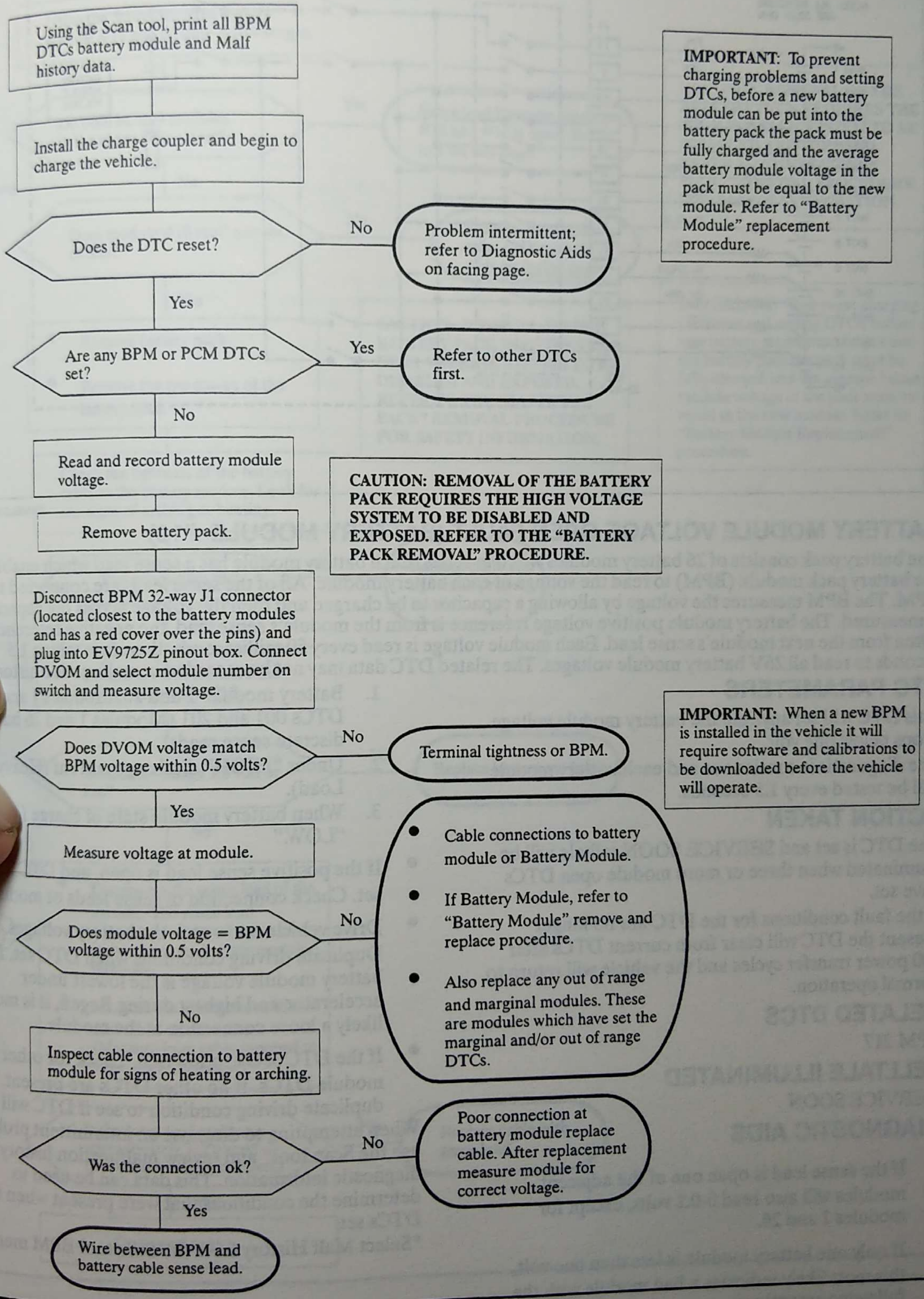
SERVICE NOW and REDUCED PERFORMANCE

DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

DTC 135
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #17)

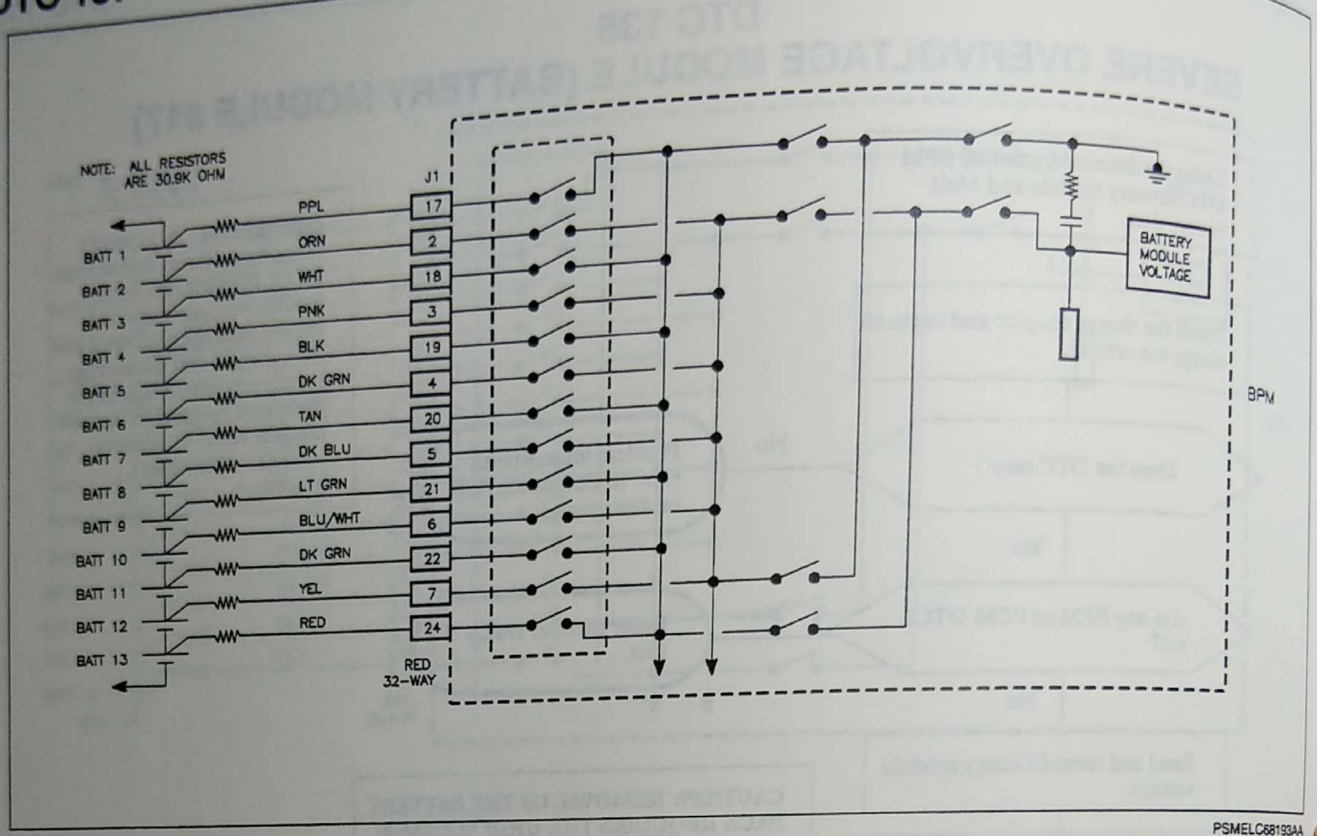

Using the Scan tool, print all BPM DTCs battery module and Malf history data.
Install the charge coupler and begin to charge the vehicle.
Does the DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any BPM or PCM DTCs set?
Yes
Refer to other DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
No
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 137 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #18)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:

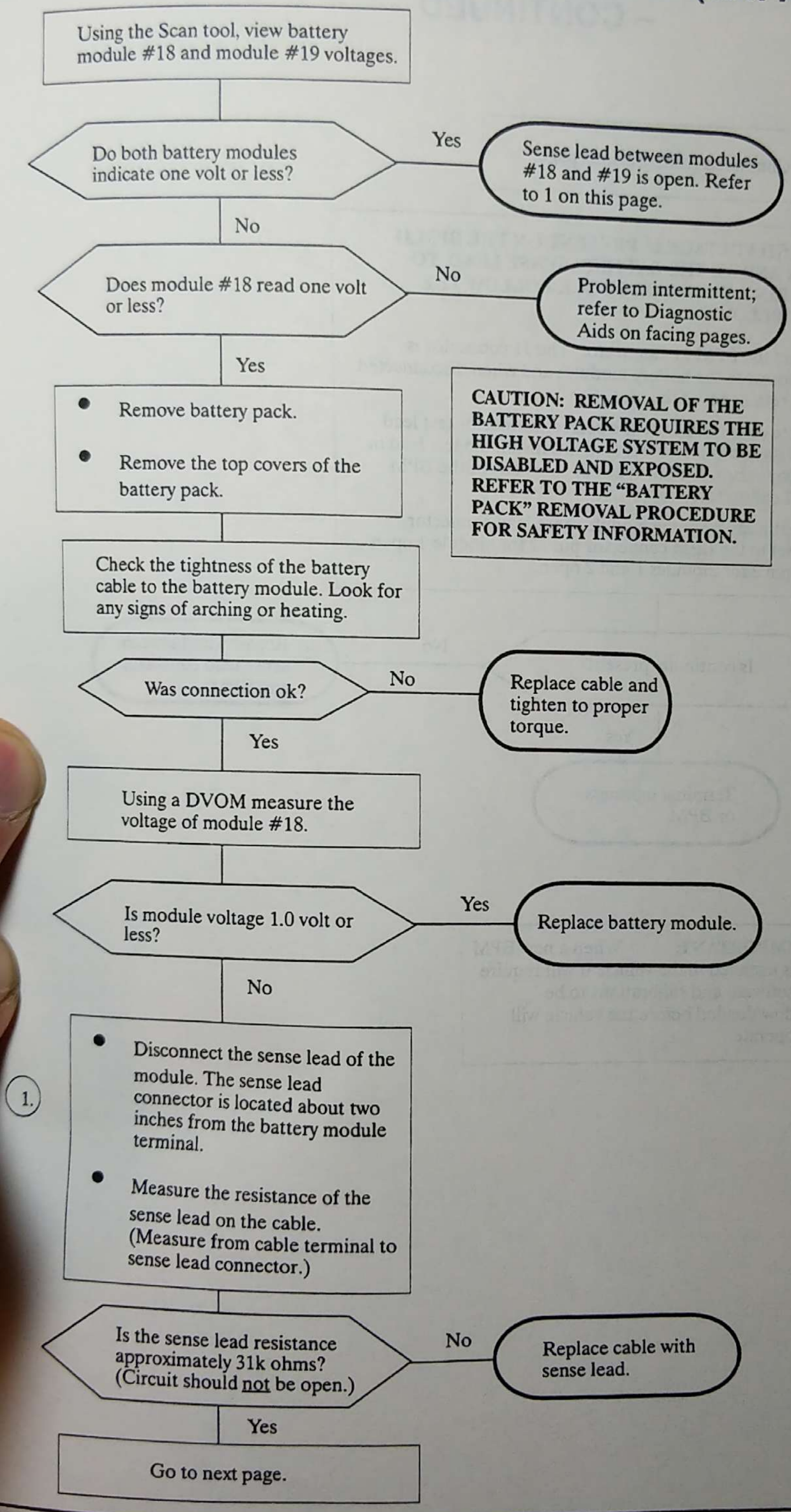
1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
2. Under "HIGH" discharge current (Heavy Load).
3. When battery module state of charge (SOC) is "LOW."

- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 137
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #18)



Using the Scan tool, view battery module #18 and module #19 voltages.

Do both battery modules indicate one volt or less?

Yes: Sense lead between modules #18 and #19 is open. Refer to 1 on this page.

No: Does module #18 read one volt or less?

No: Problem intermittent; refer to Diagnostic Aids on facing pages.

Yes:

- Remove battery pack.
- Remove the top covers of the battery pack.

Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.

Was connection ok?

No: Replace cable and tighten to proper torque.

Yes: Using a DVOM measure the voltage of module #18.

Is module voltage 1.0 volt or less?

Yes: Replace battery module.

No:

1.
- Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
- Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)

Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)

No: Replace cable with sense lead.

Yes: Go to next page.

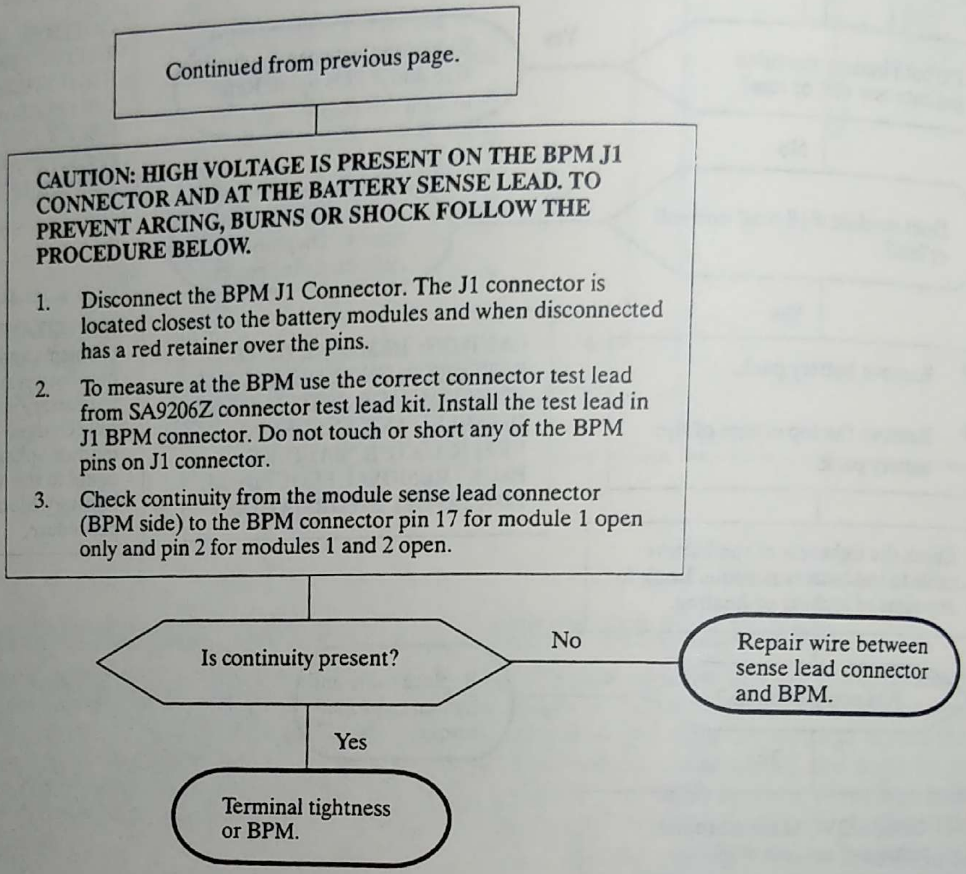
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 137

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #18) – CONTINUED


Continued from previous page.
Is continuity present?
No
Repair wire between sense lead connector and BPM.
Yes
Terminal tightness or BPM.

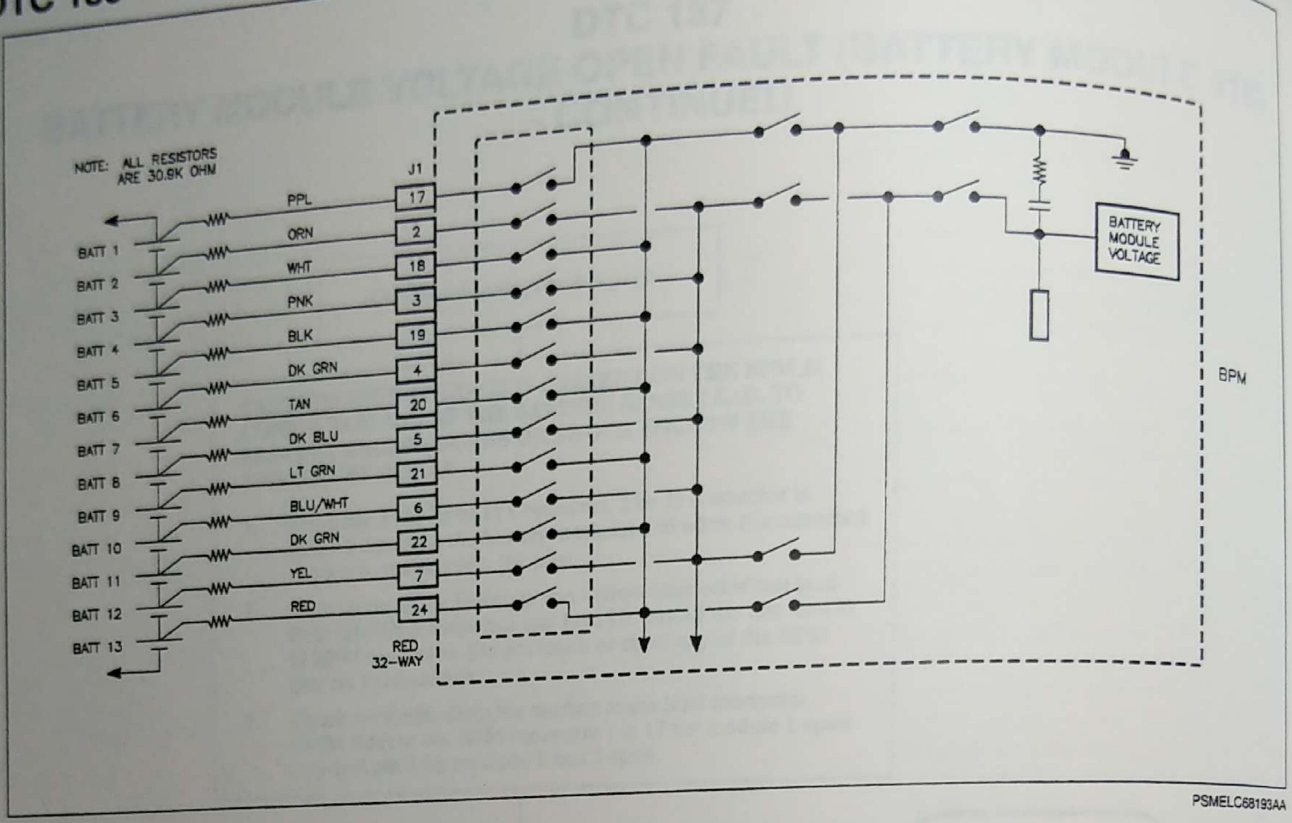
CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 139 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #18)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #18: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

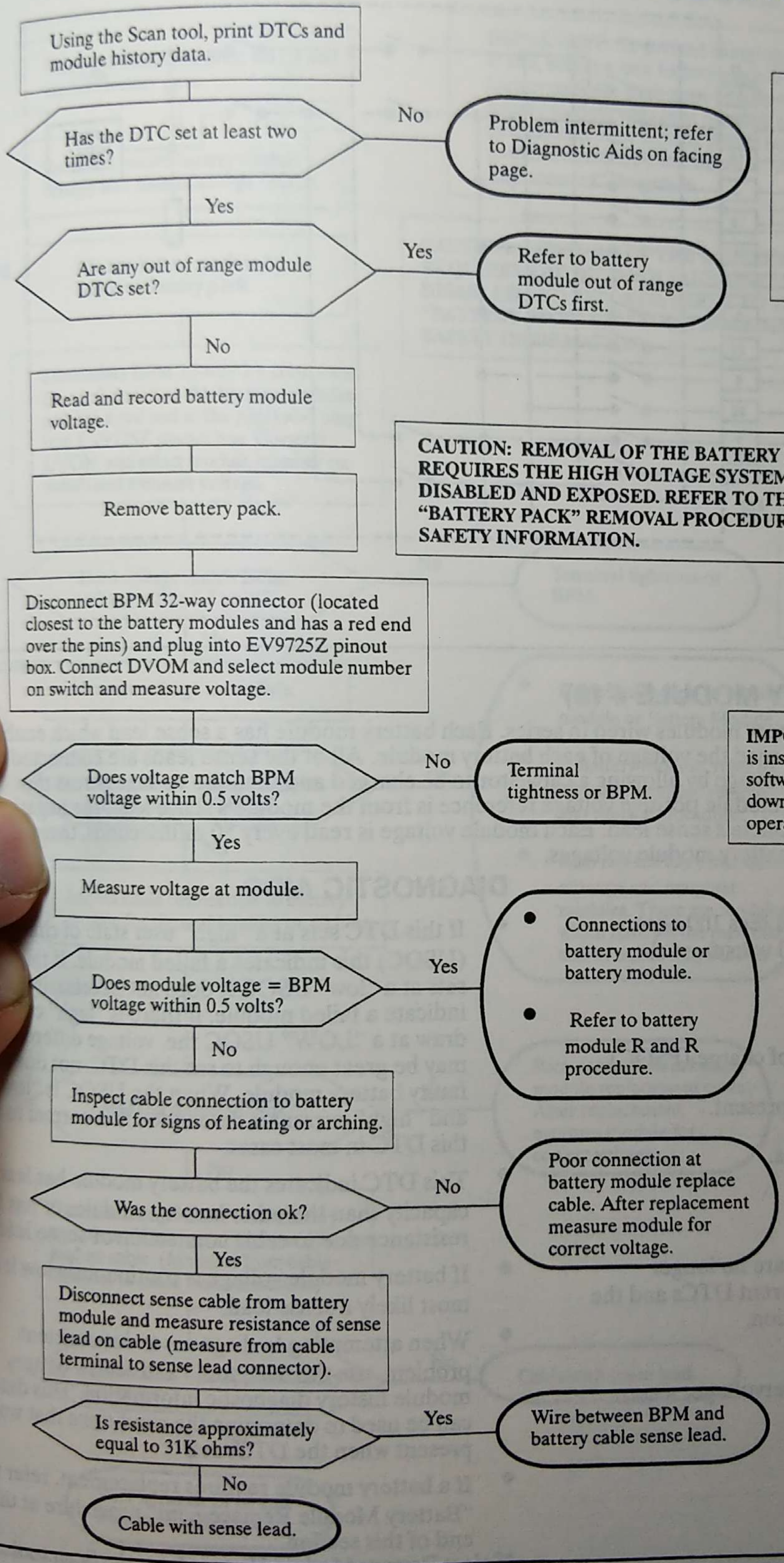
*Select Battery Module History from the Scan tool BPM menu.

DTC 139
MARGINAL (BATTERY MODULE #18)

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.



Using the Scan tool, print DTCs and module history data.

Has the DTC set at least two times?

Problem intermittent; refer to Diagnostic Aids on facing page.

Are any out of range module DTCs set?

Refer to battery module out of range DTCs first.

Read and record battery module voltage.

Remove battery pack.

Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Connections to battery module or battery module.
- Refer to battery module R and R procedure.

Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Poor connection at battery module replace cable. After replacement measure module for correct voltage.

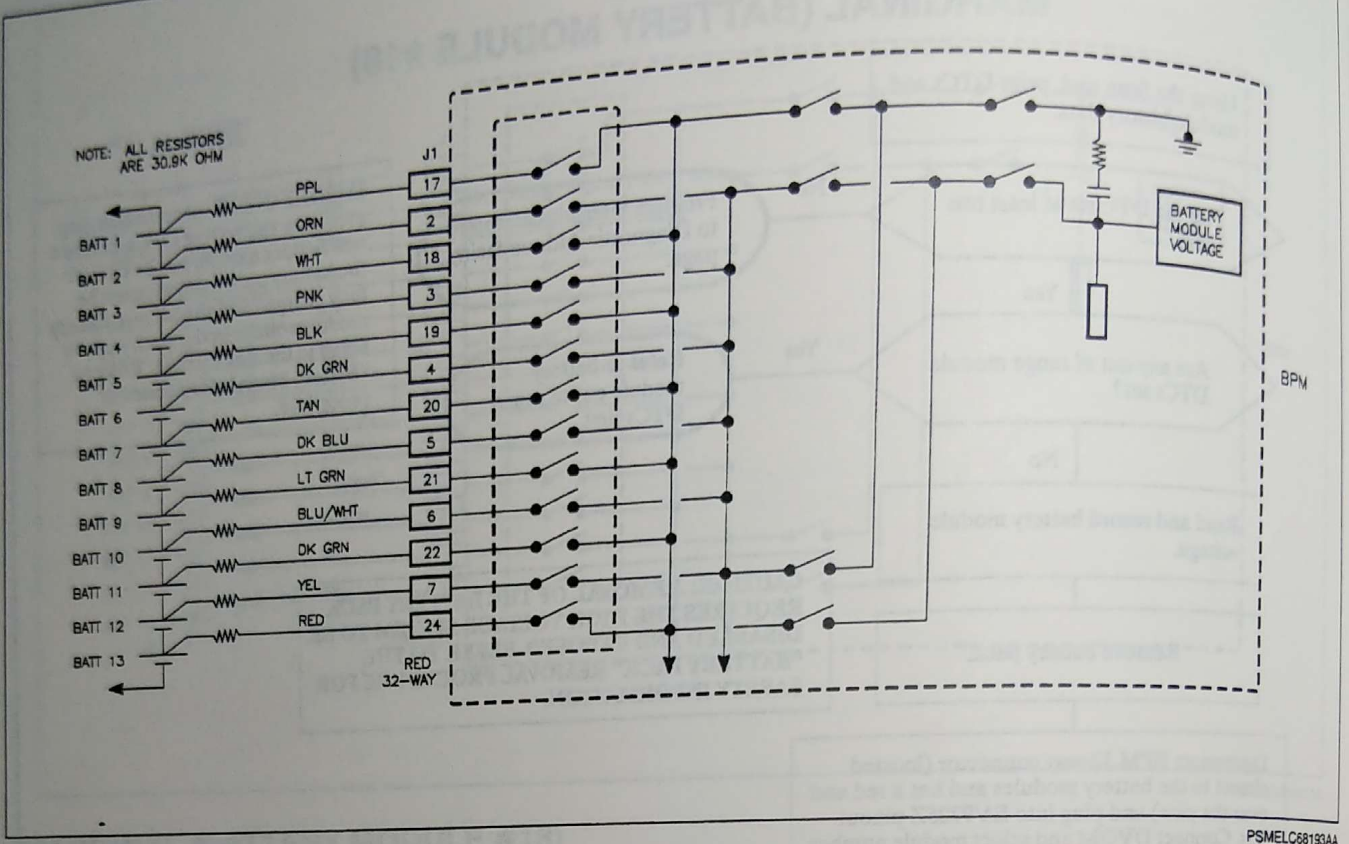
Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).

Is resistance approximately equal to 31K ohms?

Wire between BPM and battery cable sense lead.

Cable with sense lead.

DTC 140 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #18)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #18: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

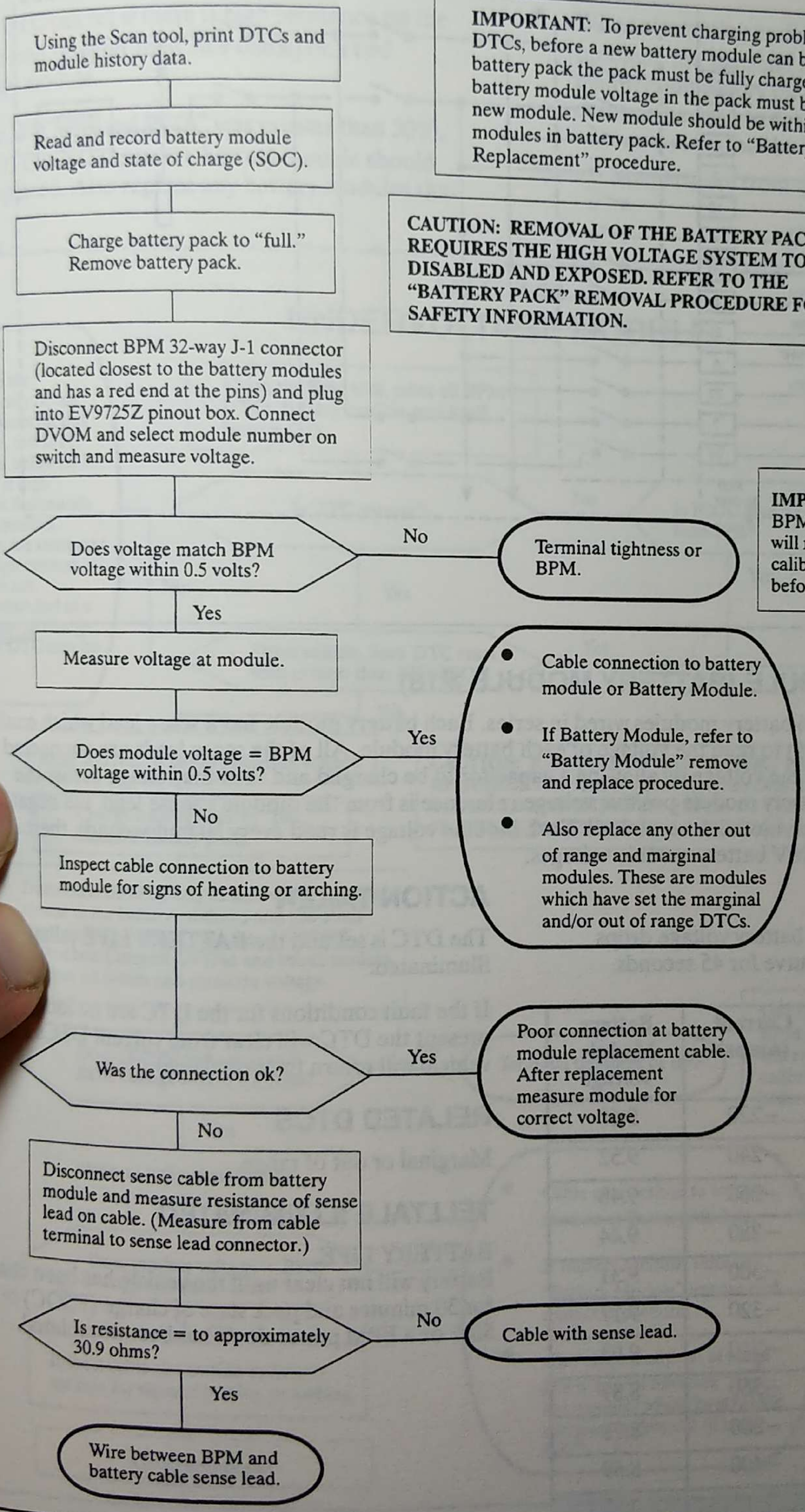
- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

*Select Battery Module History from the Scan tool BPM menu.

DTC 140
OUT OF RANGE (BATTERY MODULE #18)

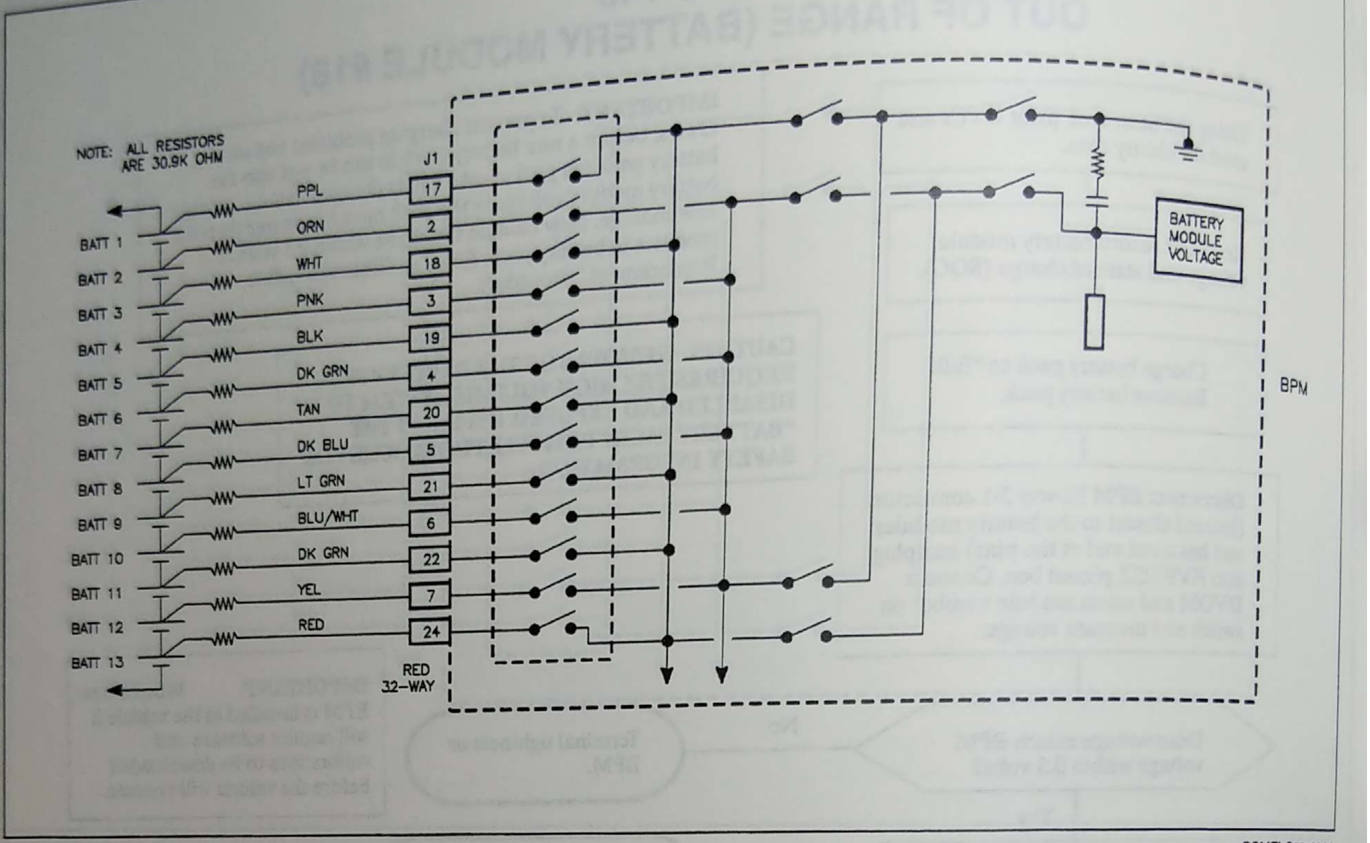
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.


Using the Scan tool, print DTCs and module history data.
Read and record battery module voltage and state of charge (SOC).
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Cable connection to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
Yes
Poor connection at battery module replacement cable. After replacement measure module for correct voltage.
No
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance = to approximately 30.9 ohms?
No
Cable with sense lead.
Yes
Wire between BPM and battery cable sense lead.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 141 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #18)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage
0	11.75
−20	11.10
−40	10.90
−60	10.65
−80	10.45
−100	10.30
−120	10.15
−140	10.00
−160	9.90
−180	9.80
−200	9.70
−220	9.60
−240	9.52
−260	9.48
−280	9.44
−300	9.31
−320	9.17
−340	9.03
−360	8.87
−380	8.73
−400	8.59

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range.

TELLTALE ILLUMINATED

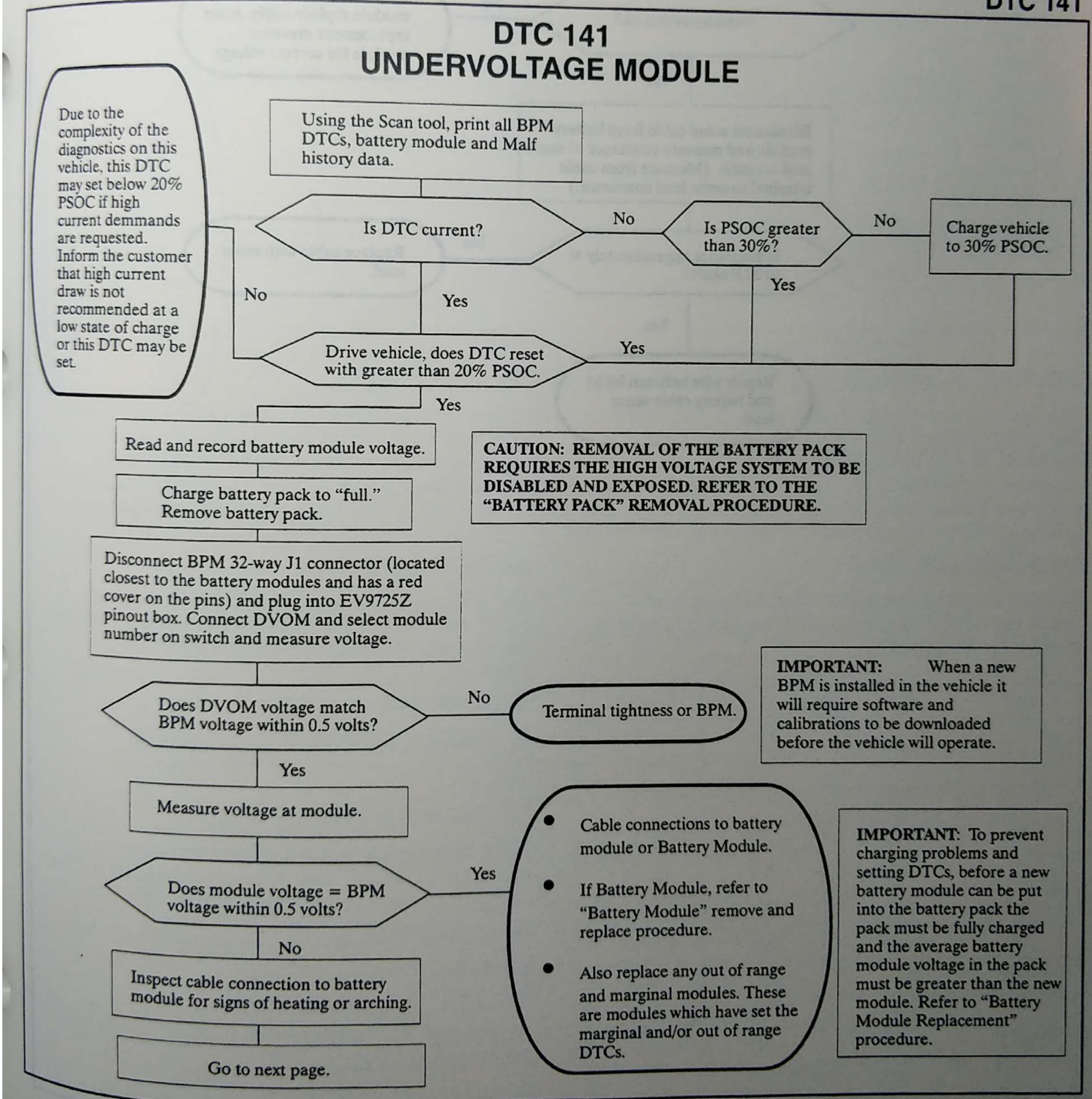
BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below zero percent user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 141
UNDERVOLTAGE MODULE



Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

Using the Scan tool, print all BPM DTCs, battery module and Malf history data.

Is DTC current?

Is PSOC greater than 30%?

Charge vehicle to 30% PSOC.

Drive vehicle, does DTC reset with greater than 20% PSOC.

Read and record battery module voltage.

Charge battery pack to "full." Remove battery pack.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

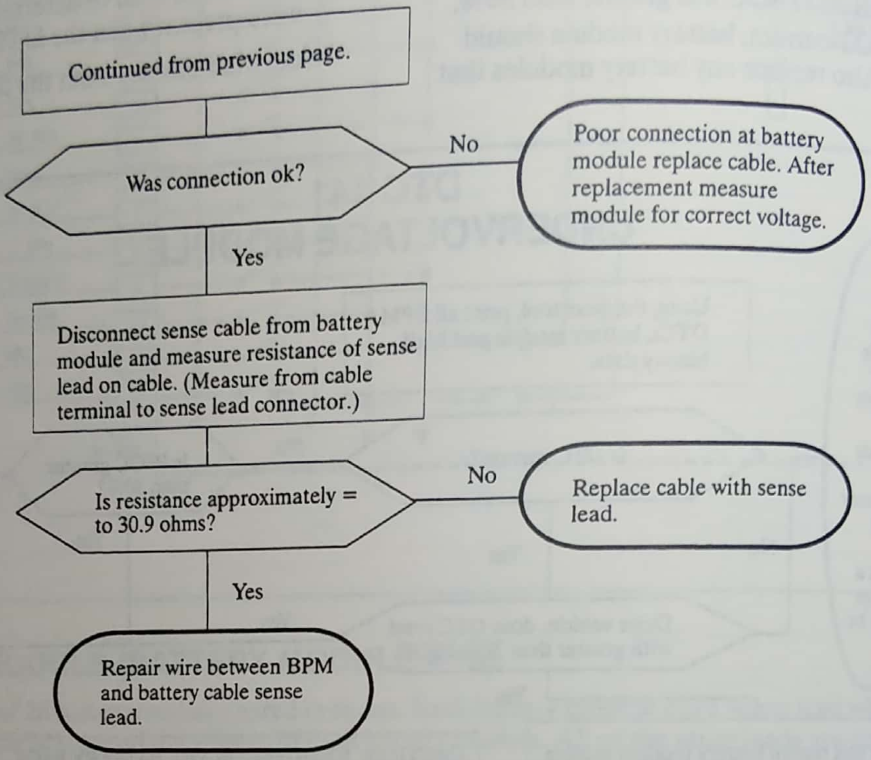
- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

Inspect cable connection to battery module for signs of heating or arching.

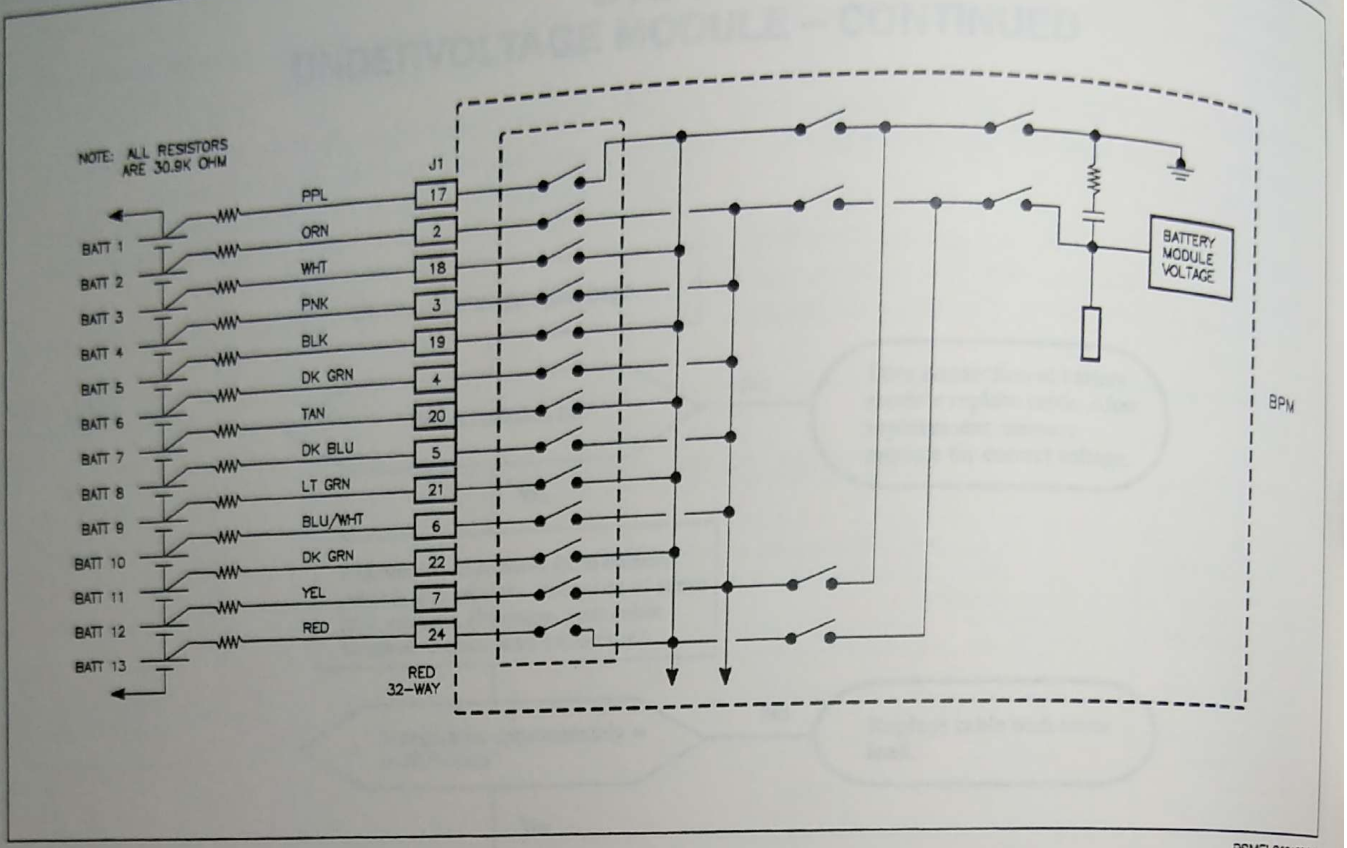
Go to next page.

DTC 141
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 142 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED
32-WAY
BATTERY MODULE VOLTAGE
BPM
PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #18)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

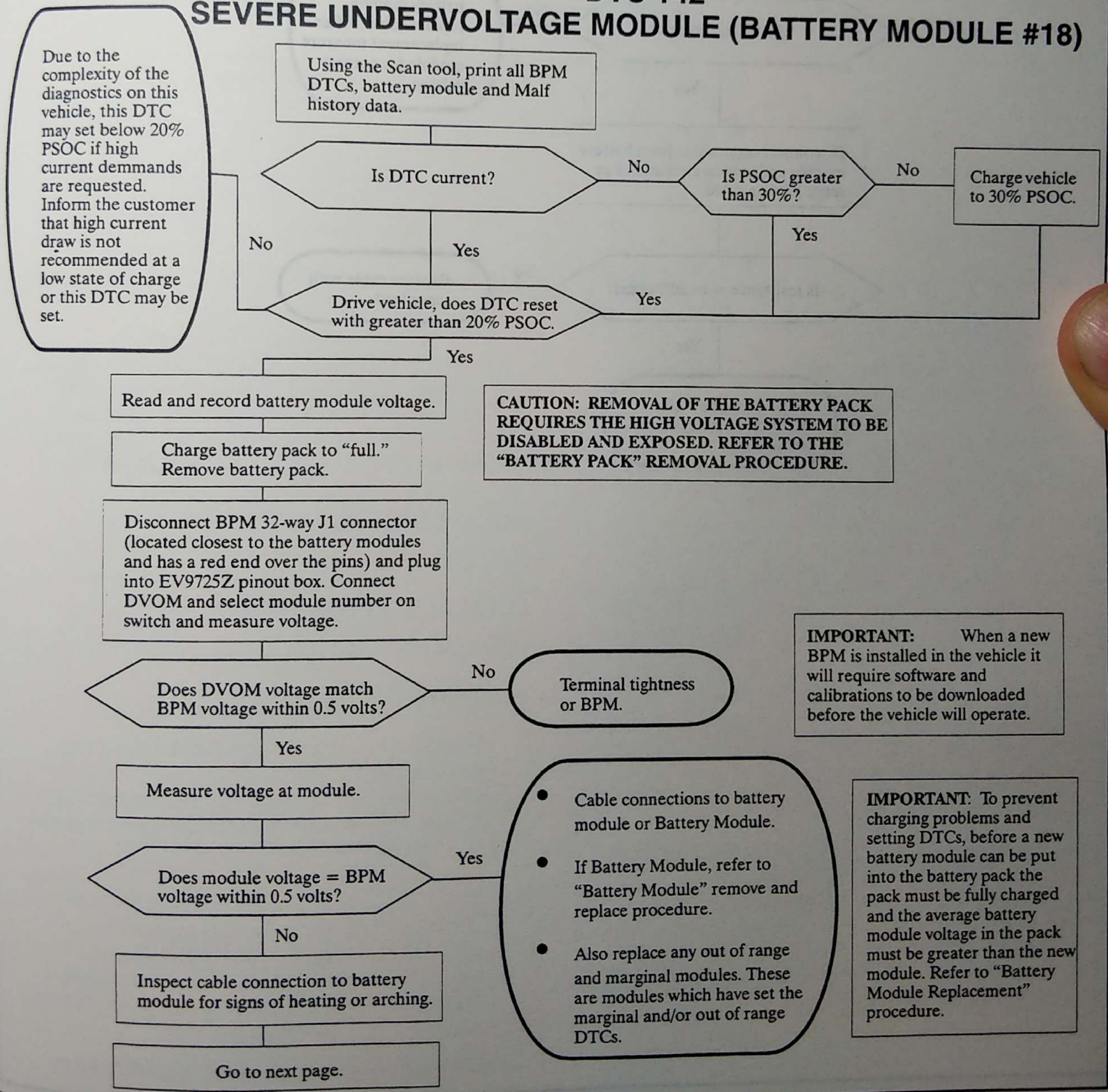
Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches zero percent user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 142
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #18)


Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.
Cable connections to battery module or Battery Module.
If Battery Module, refer to "Battery Module" remove and replace procedure.
Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

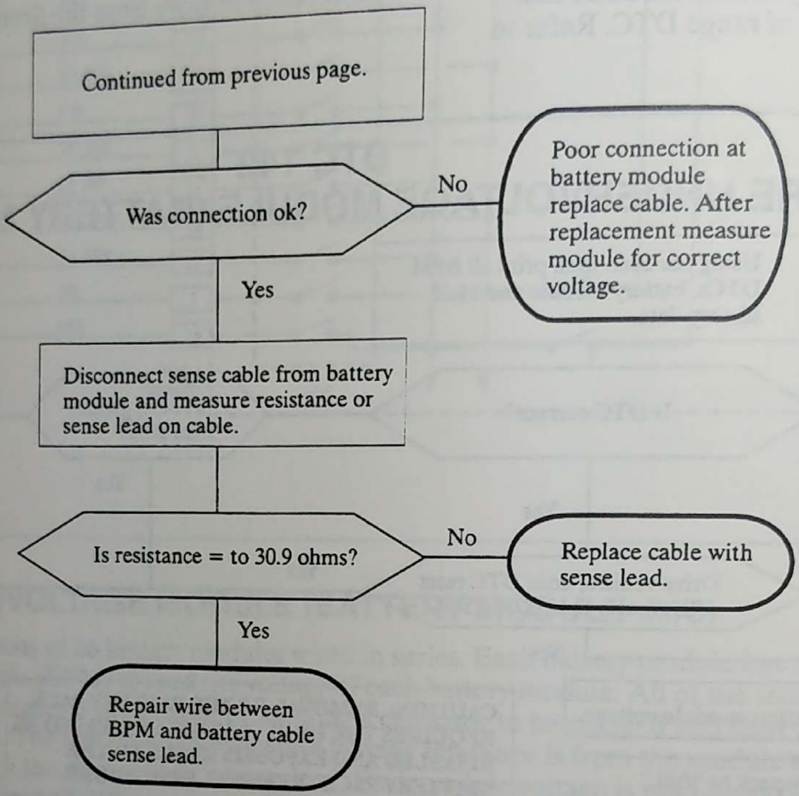
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

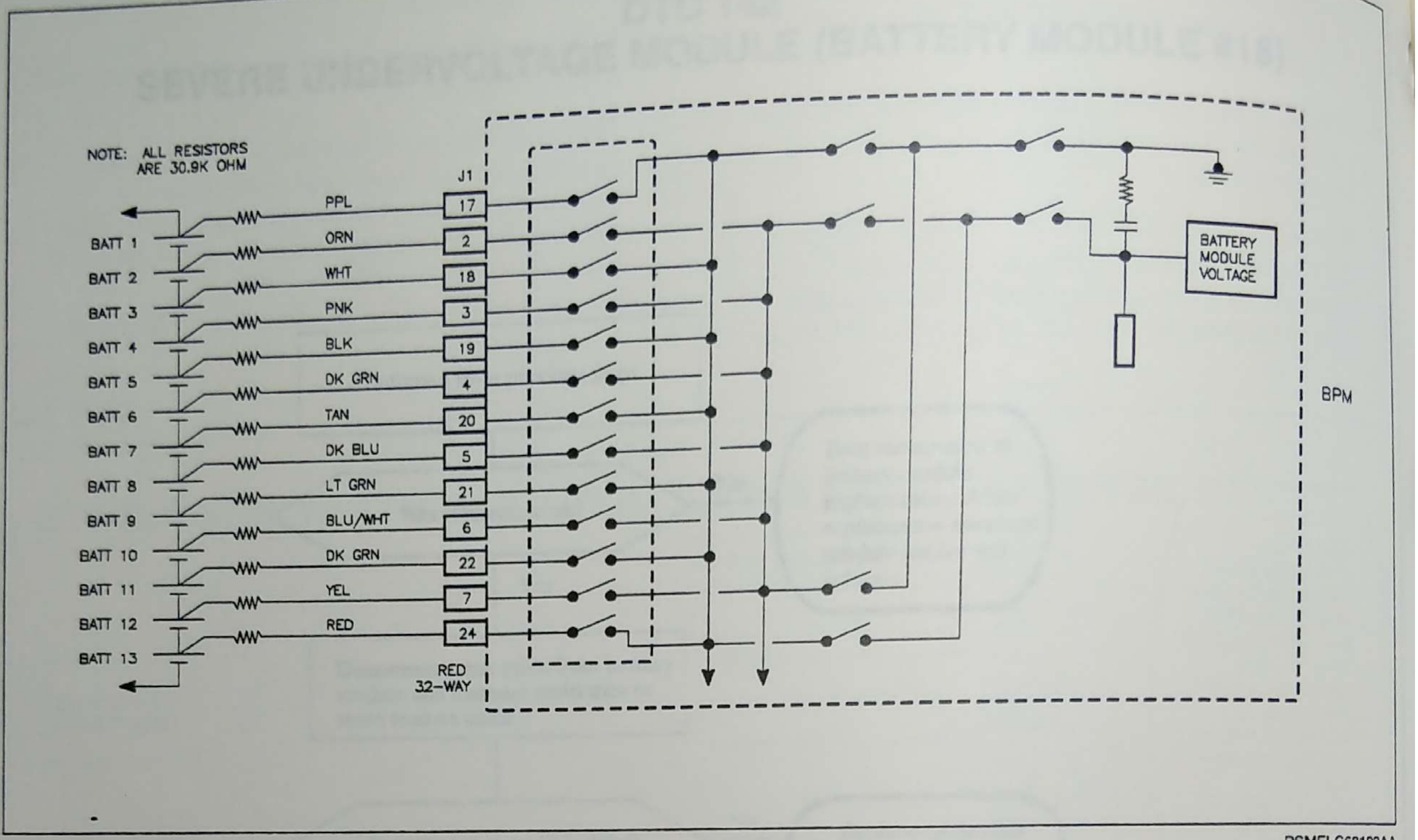
DTC 142

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #18)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 143 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #18)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

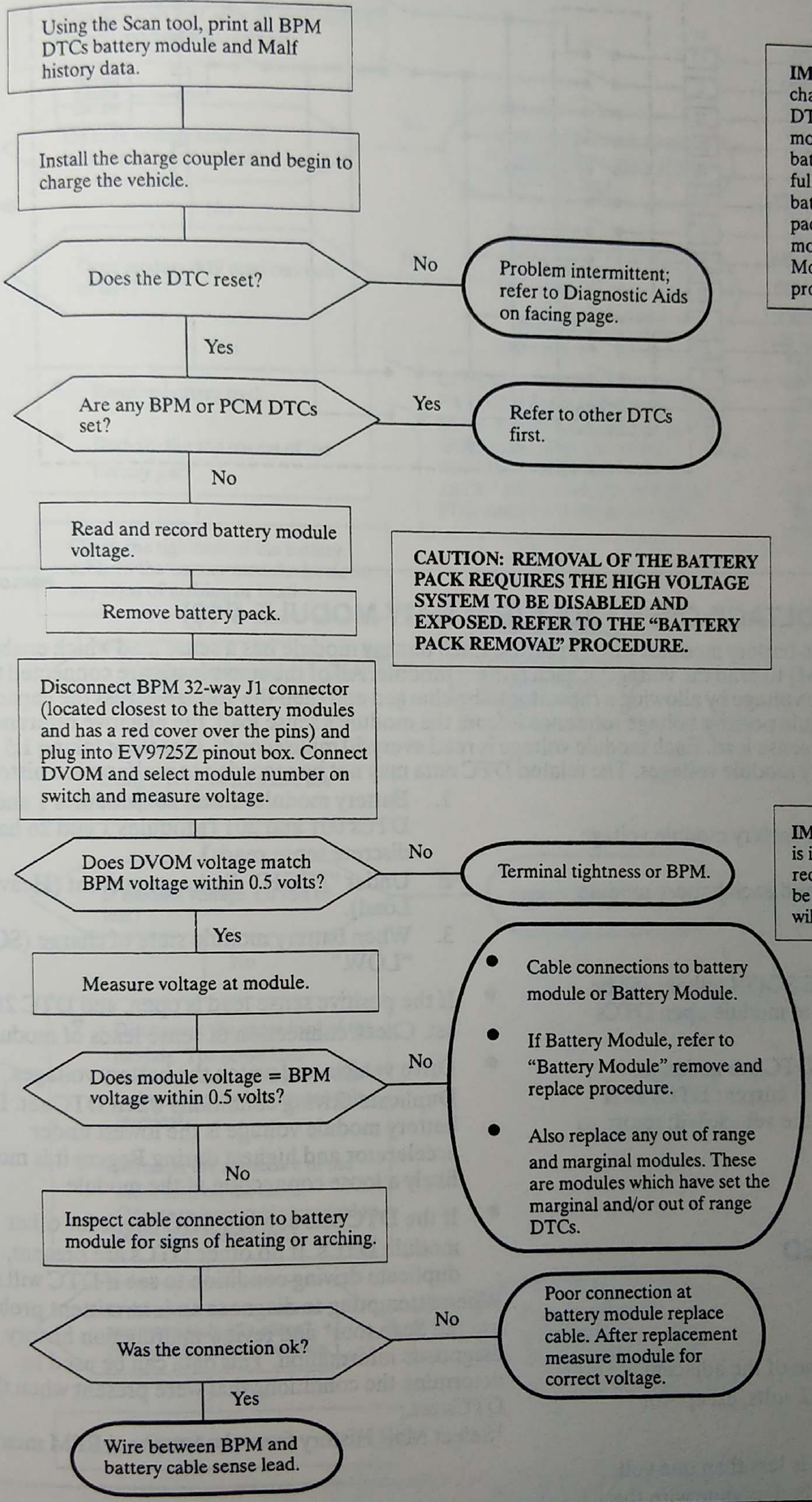
SERVICE NOW and REDUCED PERFORMANCE

DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

DTC 143
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #18)

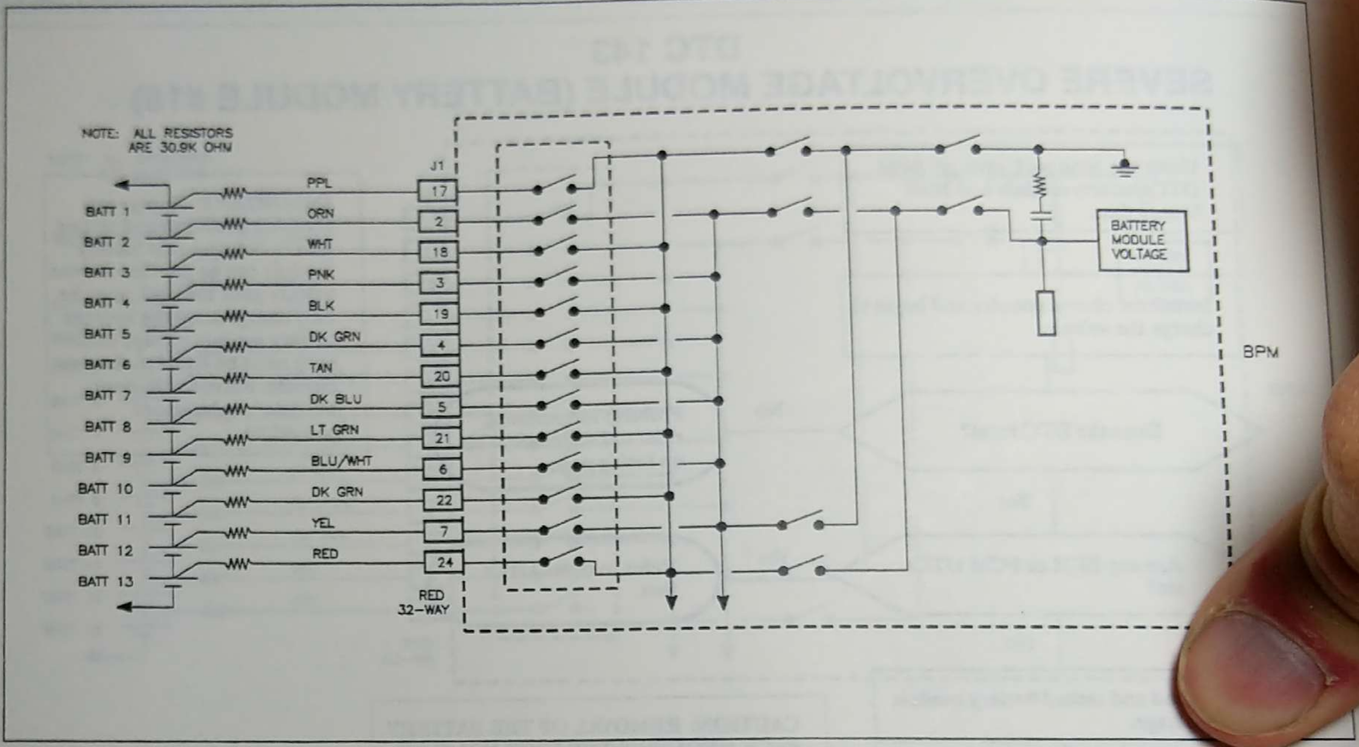

Using the Scan tool, print all BPM DTCs battery module and Malf history data.
Install the charge coupler and begin to charge the vehicle.
Does the DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any BPM or PCM DTCs set?
Yes
Refer to other DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
No
Cable connections to battery module or Battery Module.
If Battery Module, refer to "Battery Module" remove and replace procedure.
Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Wire between BPM and battery cable sense lead.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 145 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #19)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:

1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
2. Under "HIGH" discharge current (Heavy Load).
3. When battery module state of charge (SOC) is "LOW."

- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset

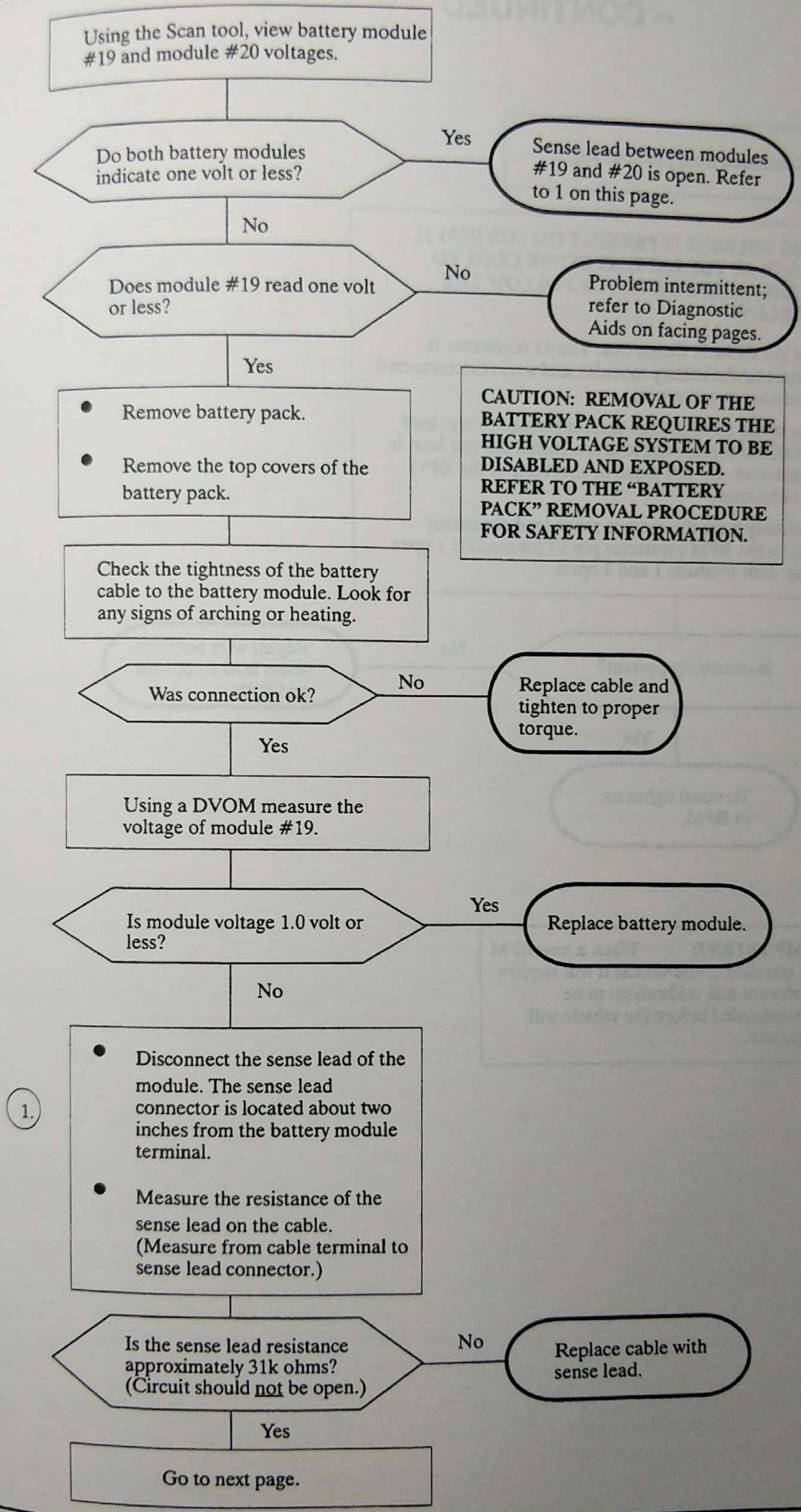
When attempting to diagnose an intermittent problem use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

CS CamScanner

DTC 145

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #19)


Using the Scan tool, view battery module #19 and module #20 voltages.
Do both battery modules indicate one volt or less?
Yes
Sense lead between modules #19 and #20 is open. Refer to 1 on this page.
No
Does module #19 read one volt or less?
No
Problem intermittent; refer to Diagnostic Aids on facing pages.
Yes
Remove battery pack.
Remove the top covers of the battery pack.
Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.
Was connection ok?
No
Replace cable and tighten to proper torque.
Yes
Using a DVOM measure the voltage of module #19.
Is module voltage 1.0 volt or less?
Yes
Replace battery module.
No
1.
Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)
Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)
No
Replace cable with sense lead.
Yes
Go to next page.

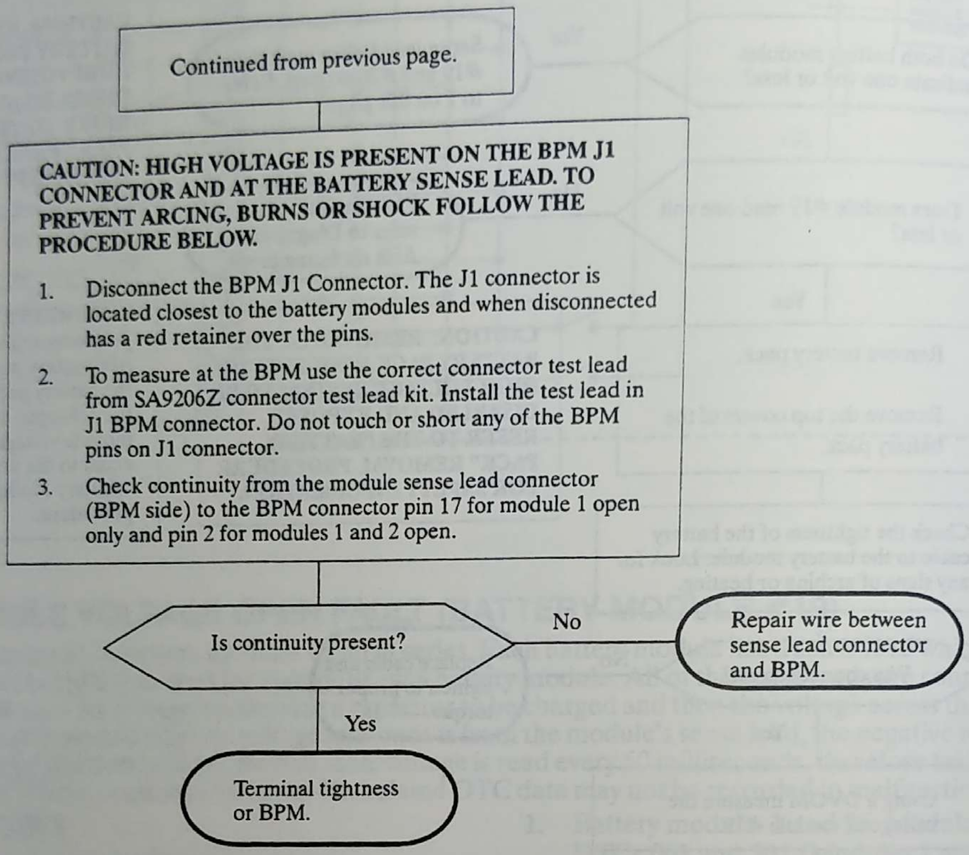
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CS CamScanner

DTC 145
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #19) – CONTINUED



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CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

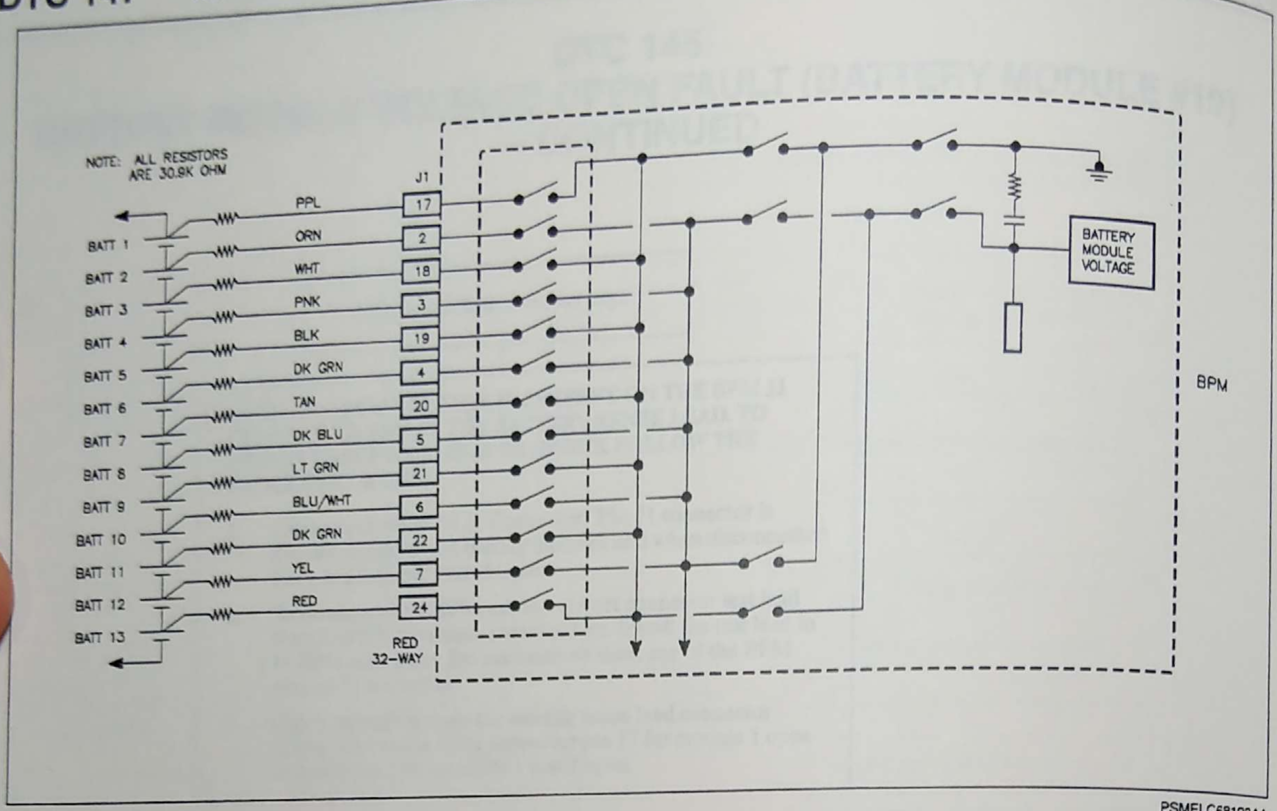
1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

Is continuity present?
No
Repair wire between sense lead connector and BPM.
Yes
Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 147 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #19)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #19: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

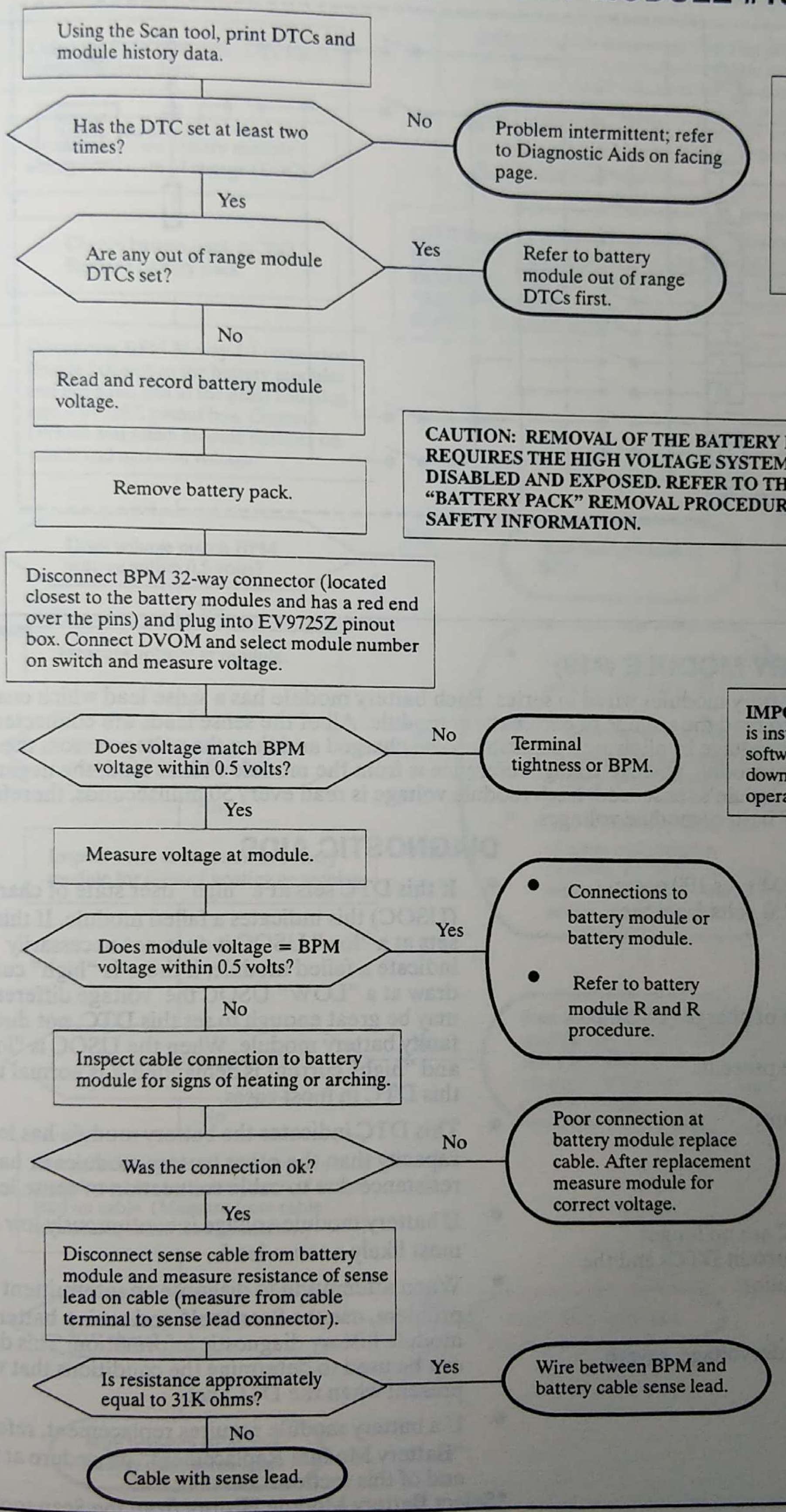
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

DTC 147
MARGINAL (BATTERY MODULE #19)

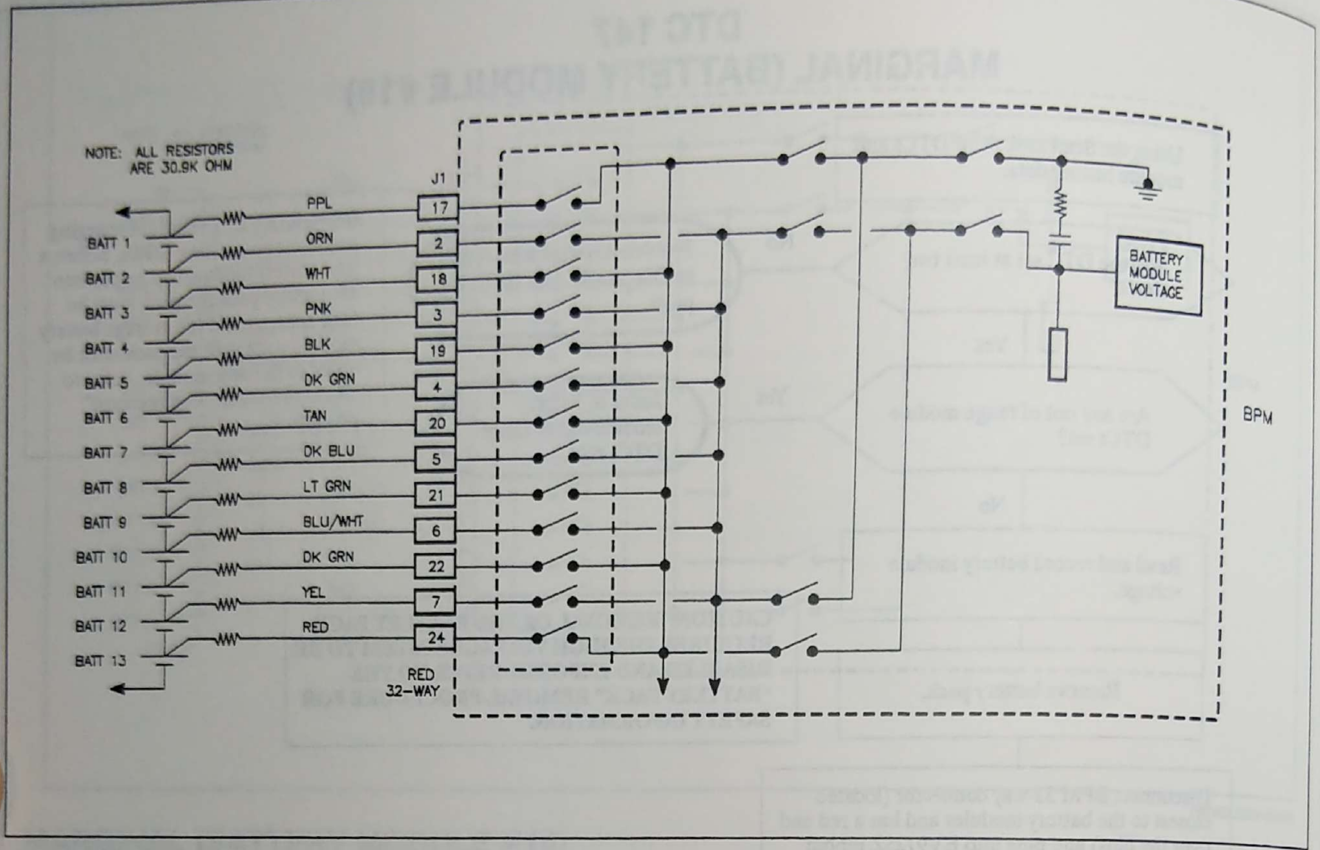

Using the Scan tool, print DTCs and module history data.
Has the DTC set at least two times?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any out of range module DTCs set?
Yes
Refer to battery module out of range DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Connections to battery module or battery module.
• Refer to battery module R and R procedure.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).
Is resistance approximately equal to 31K ohms?
Yes
Wire between BPM and battery cable sense lead.
No
Cable with sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 148 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #19)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #19: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

None

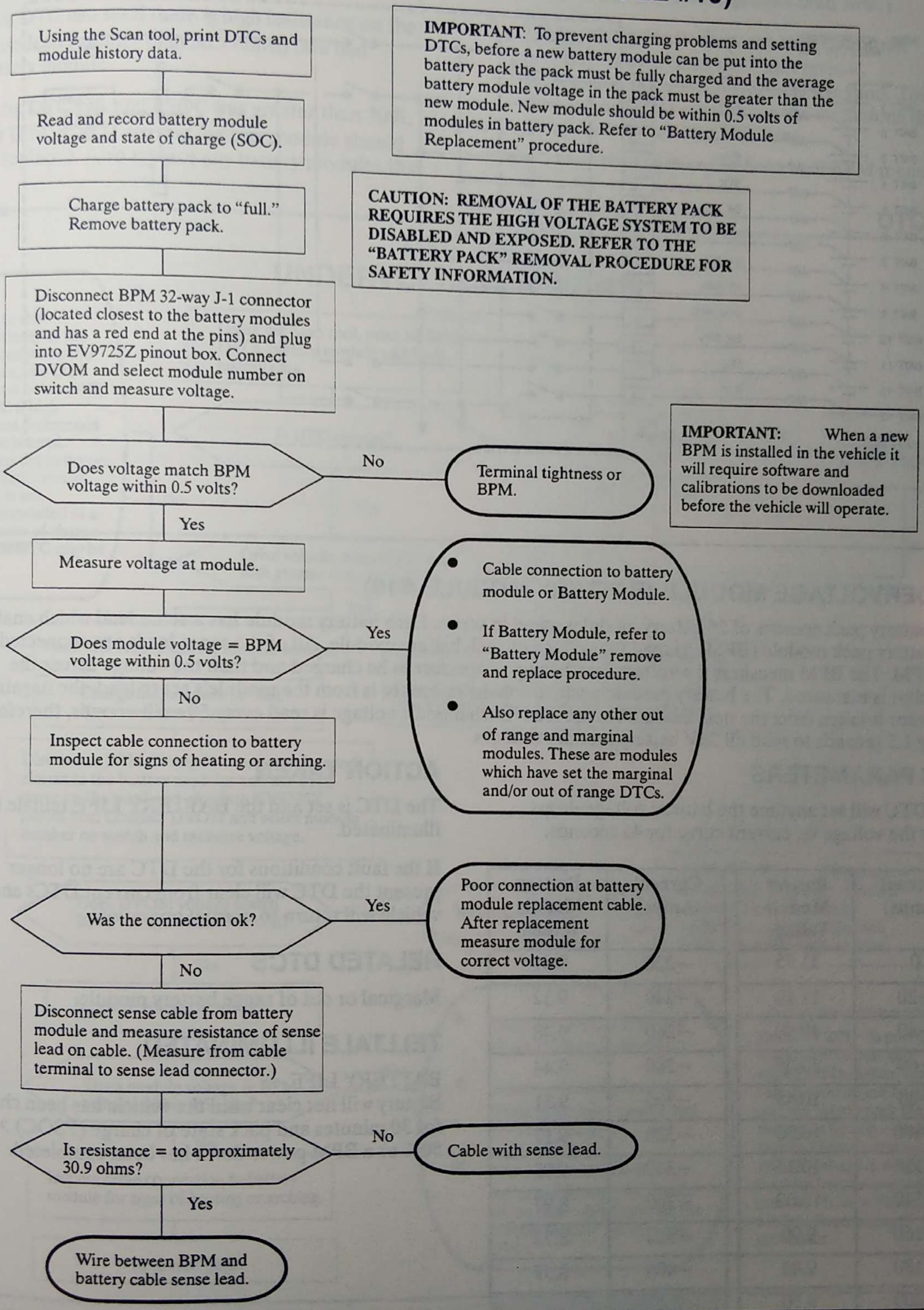
DIAGNOSTIC AIDS

- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

*Select Battery Module History from the Scan tool BPM menu.

DTC 148

OUT OF RANGE (BATTERY MODULE #19)

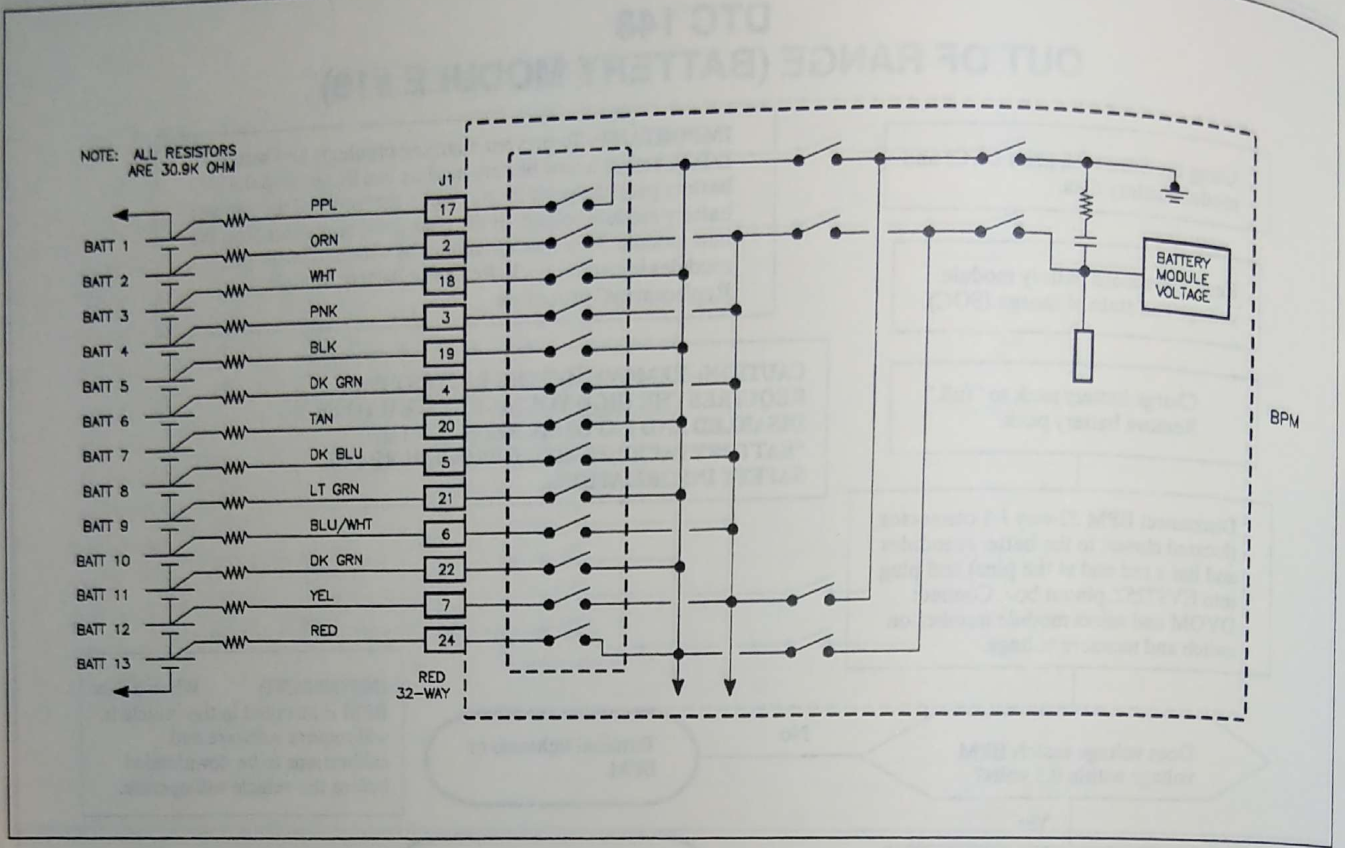

Using the Scan tool, print DTCs and module history data.
Read and record battery module voltage and state of charge (SOC).
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
Cable connection to battery module or Battery Module.
If Battery Module, refer to "Battery Module" remove and replace procedure.
Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
Yes
Poor connection at battery module replacement cable. After replacement measure module for correct voltage.
No
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance = to approximately 30.9 ohms?
No
Cable with sense lead.
Yes
Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 149 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #19)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage	Current (Amps)	Battery Module Voltage
0	11.75	−220	9.60
−20	11.10	−240	9.52
−40	10.90	−260	9.48
−60	10.65	−280	9.44
−80	10.45	−300	9.31
−100	10.30	−320	9.17
−120	10.15	−340	9.03
−140	10.00	−360	8.87
−160	9.90	−380	8.73
−180	9.80	−400	8.59
−200	9.70		

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

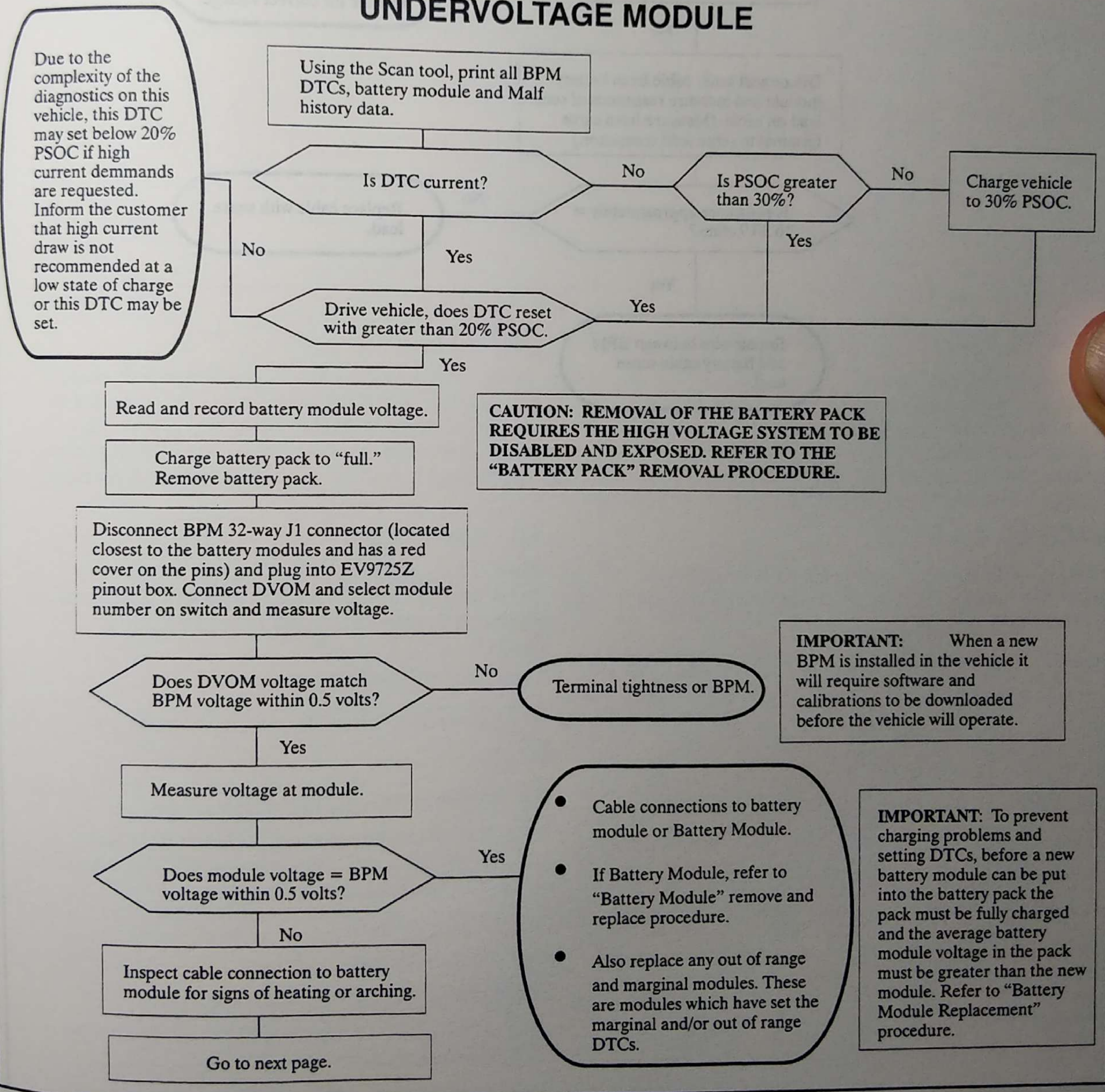
BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below zero percent user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 149
UNDERVOLTAGE MODULE



Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

Using the Scan tool, print all BPM DTCs, battery module and Malf history data.

Is DTC current?

Is PSOC greater than 30%?

Charge vehicle to 30% PSOC.

Drive vehicle, does DTC reset with greater than 20% PSOC.

Read and record battery module voltage.

Charge battery pack to "full." Remove battery pack.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

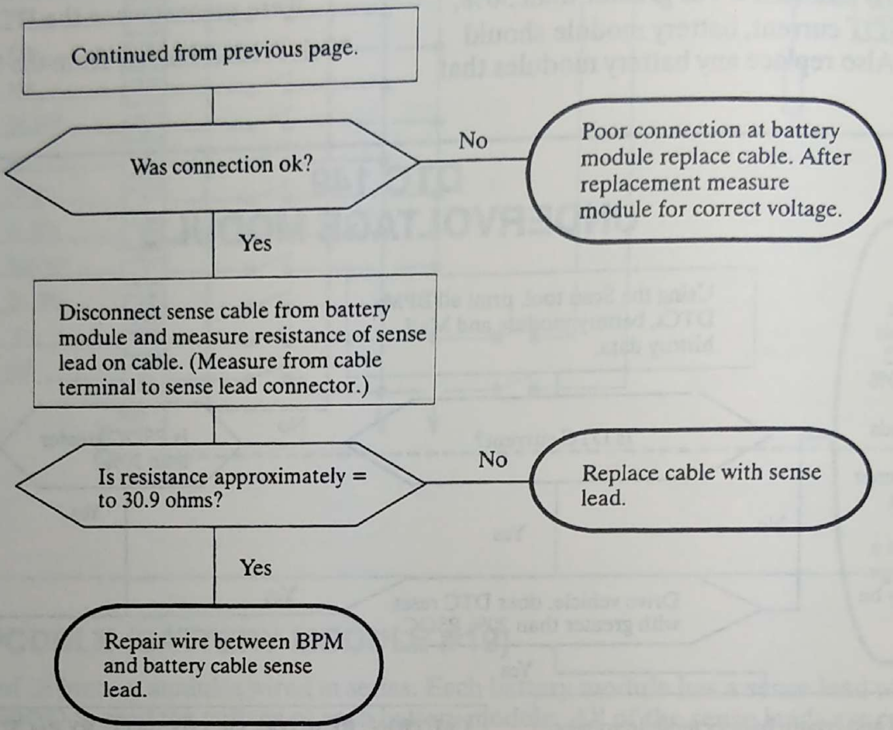
- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

Inspect cable connection to battery module for signs of heating or arching.

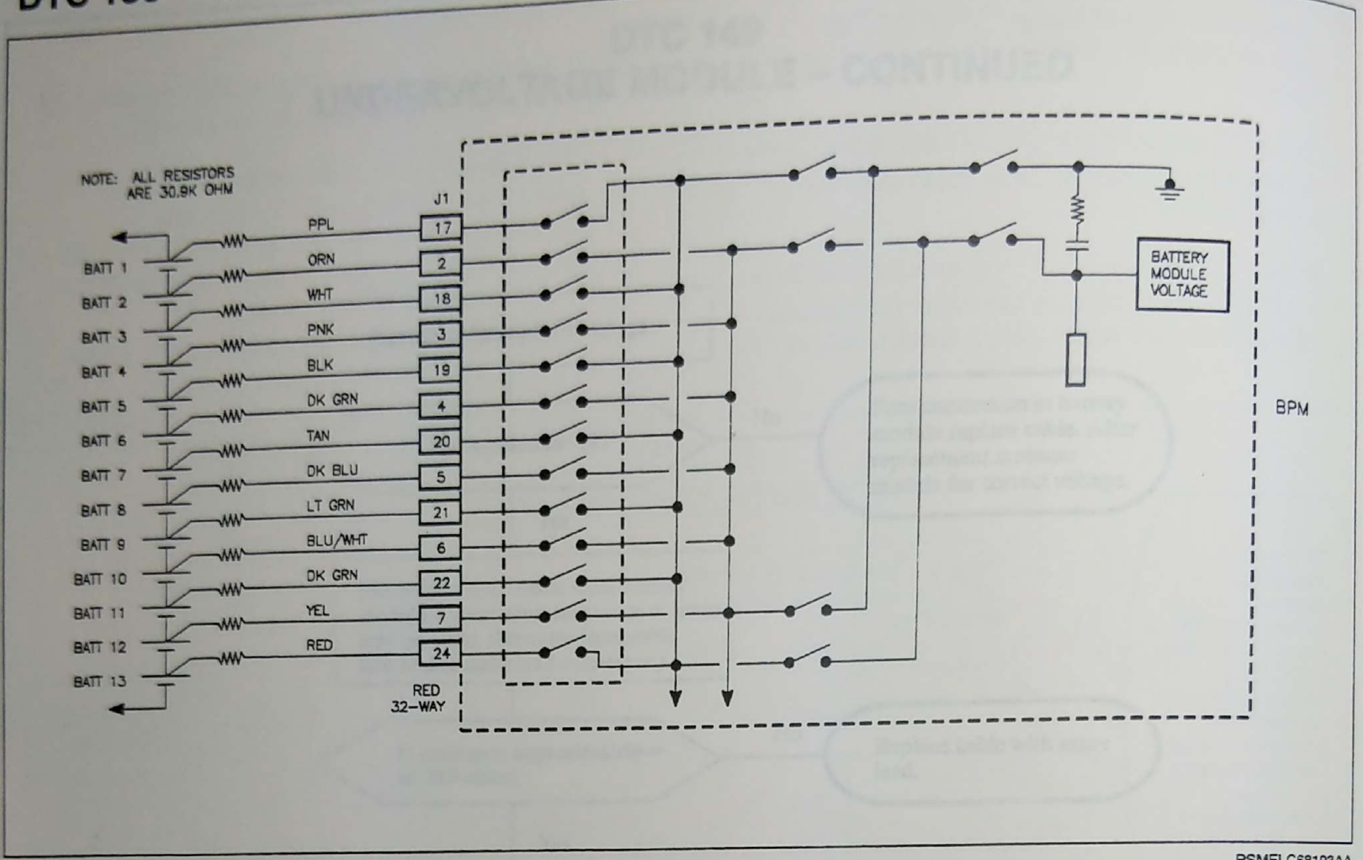
Go to next page.

DTC 149
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 150 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED
32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #19)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

CS CamScanner

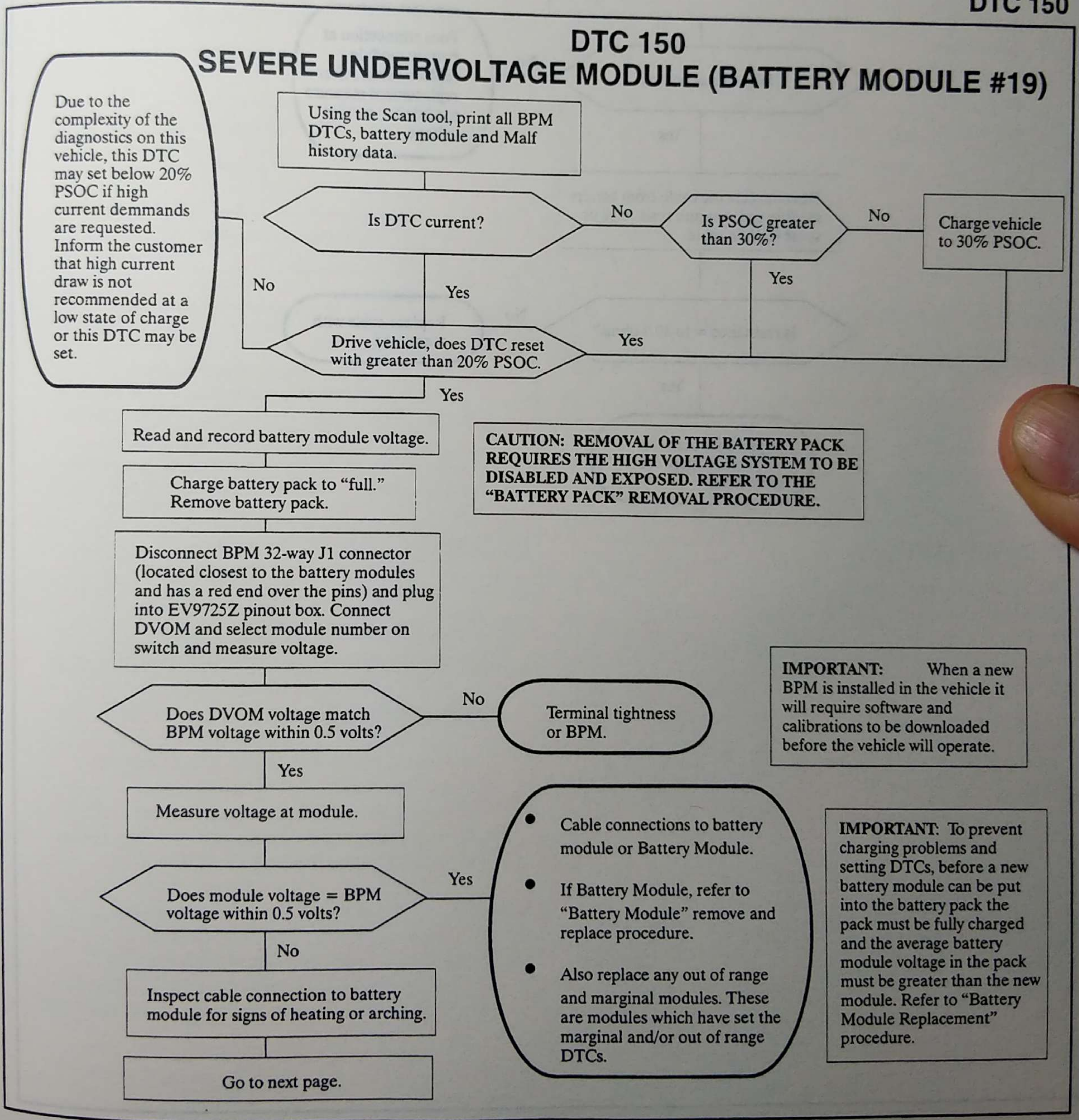
DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches zero percent user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 150

DTC 150
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #19)



Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

Using the Scan tool, print all BPM DTCs, battery module and Malf history data.

Is DTC current?

Is PSOC greater than 30%?

Charge vehicle to 30% PSOC.

Drive vehicle, does DTC reset with greater than 20% PSOC.

Read and record battery module voltage.

Charge battery pack to "full." Remove battery pack.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

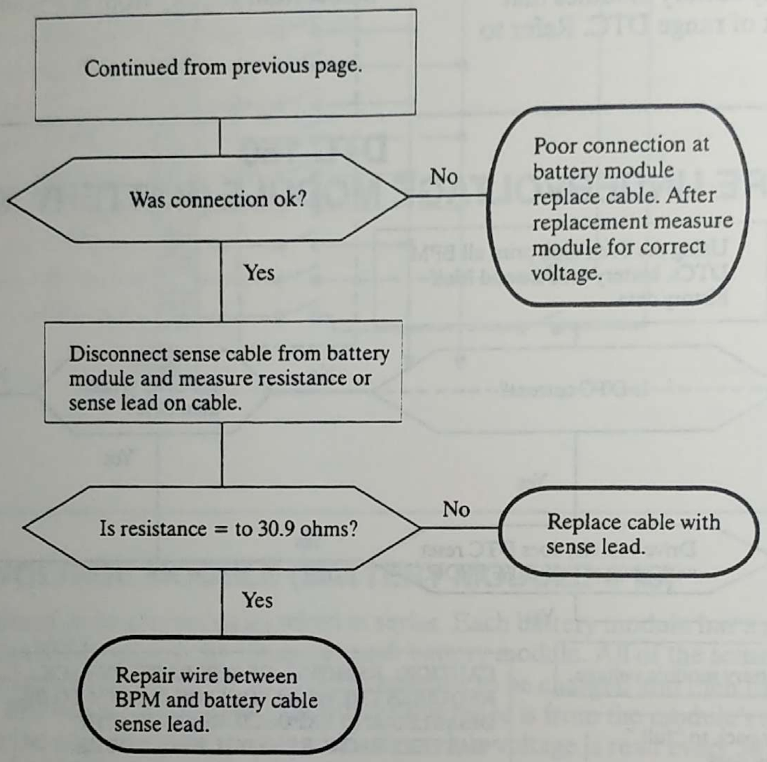
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

Inspect cable connection to battery module for signs of heating or arching.

Go to next page.

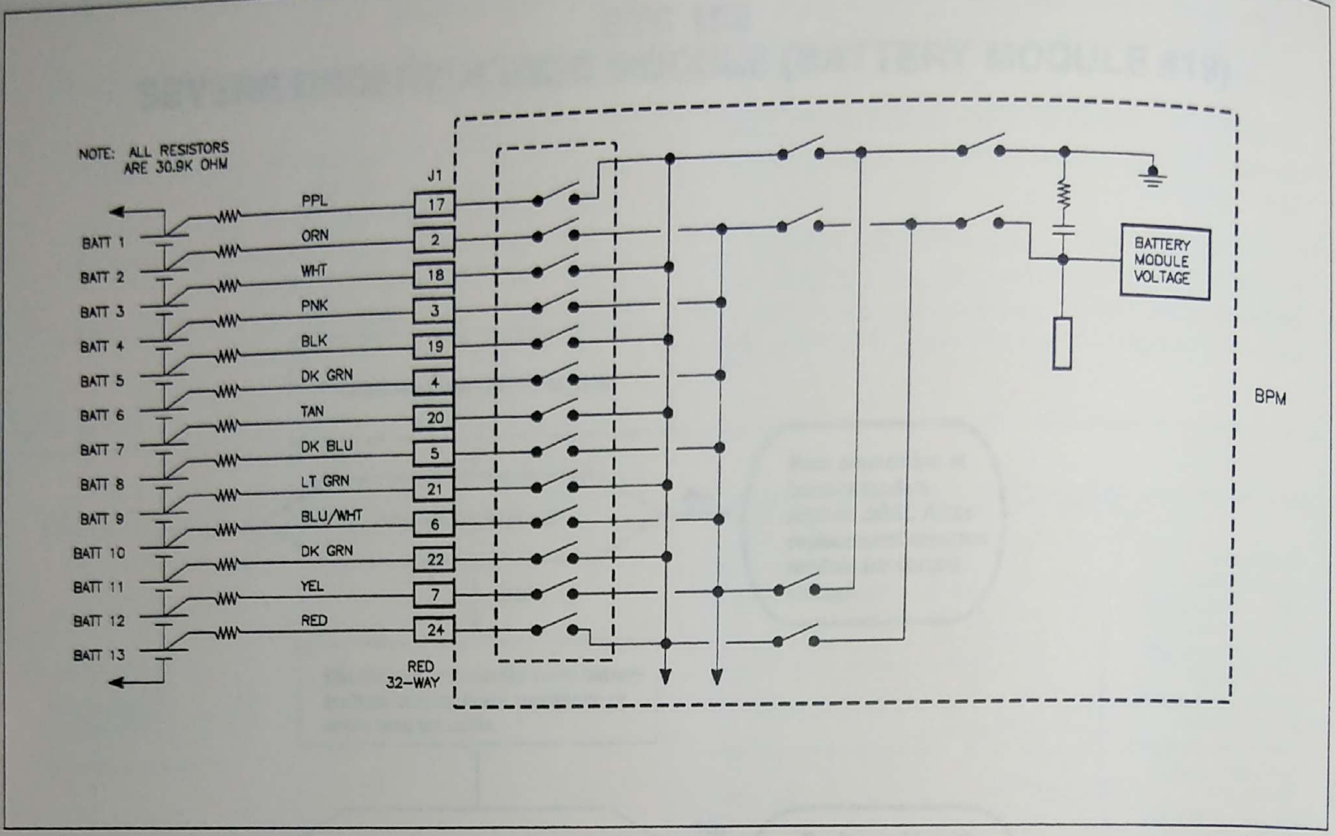
DTC 150

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #19)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 151 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #19)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

SERVICE NOW and REDUCED PERFORMANCE

DIAGNOSTIC AIDS

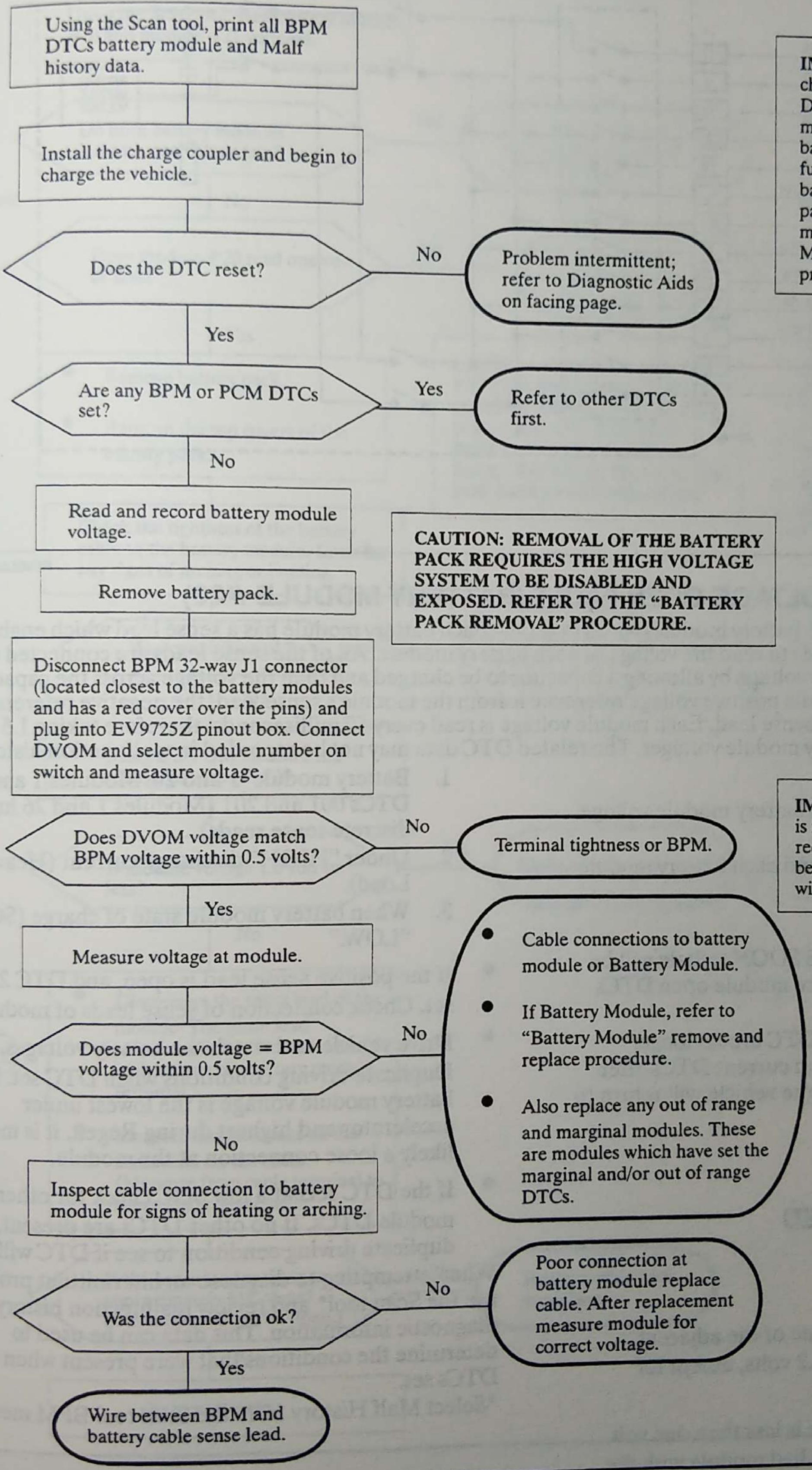
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

DTC 151

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #19)

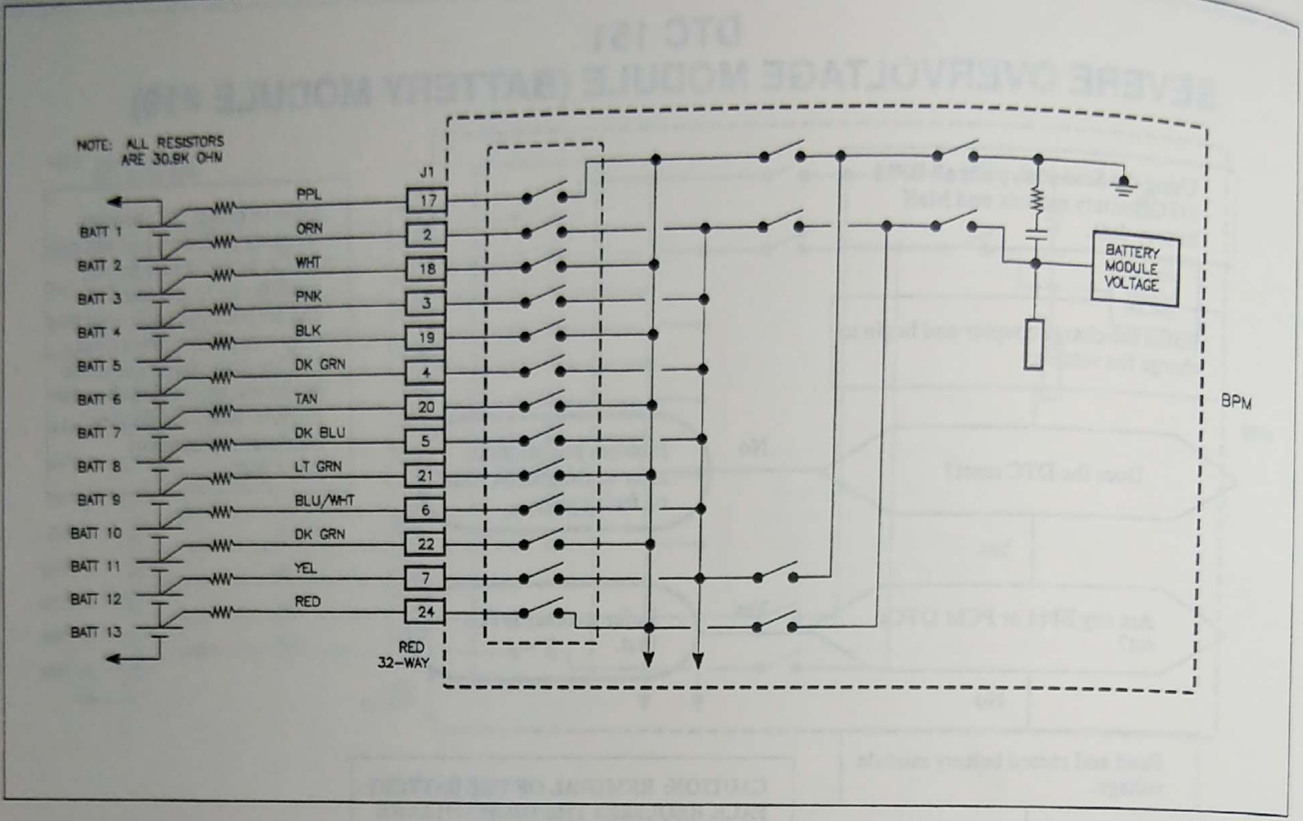
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.


Using the Scan tool, print all BPM DTCs battery module and Malf history data.
Install the charge coupler and begin to charge the vehicle.
Does the DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any BPM or PCM DTCs set?
Yes
Refer to other DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
No
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Wire between BPM and battery cable sense lead.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 153 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #20)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

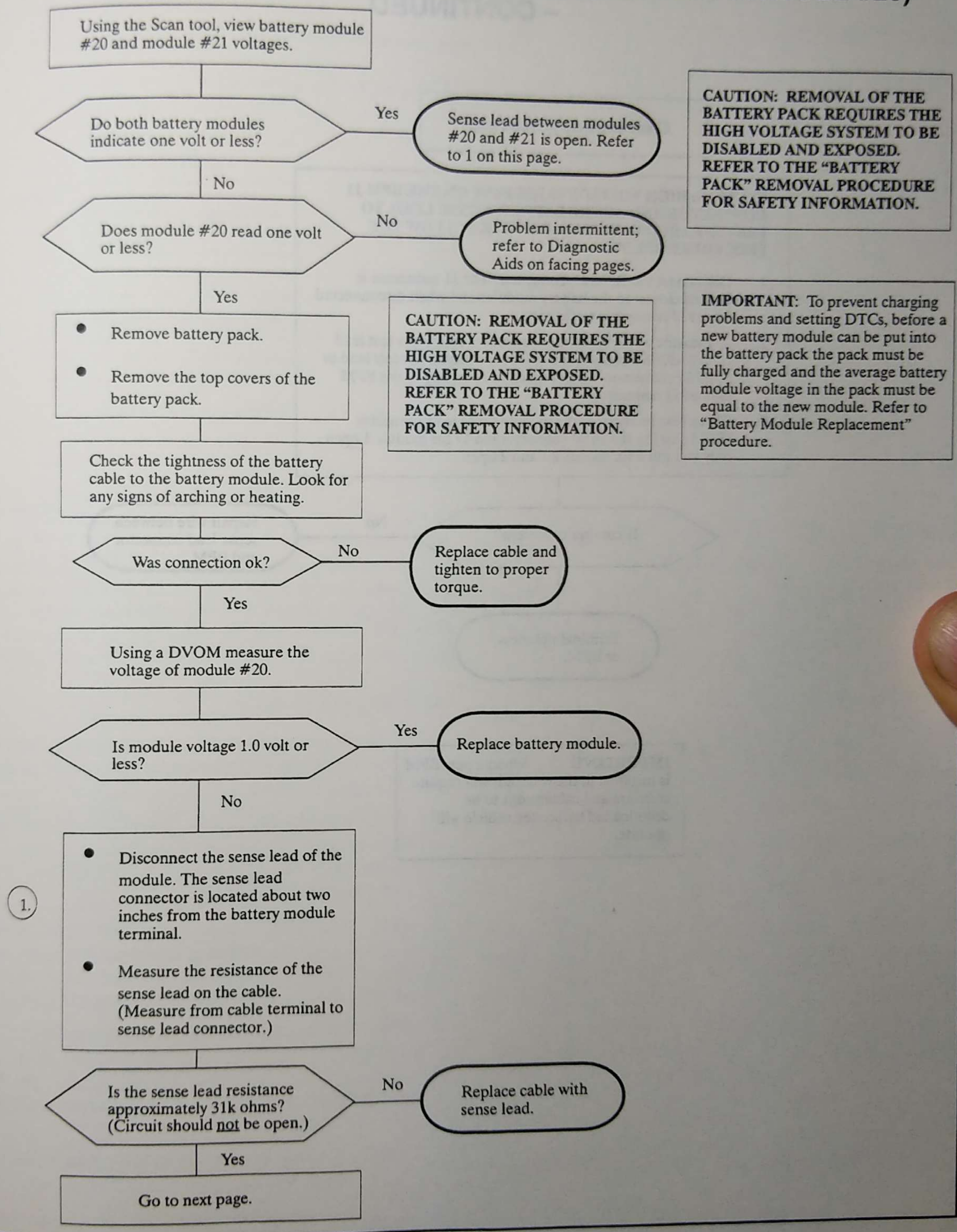
DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:
  1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
  2. Under "HIGH" discharge current (Heavy Load).
  3. When battery module state of charge (SOC) is "LOW."
- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 153
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #20)



Using the Scan tool, view battery module #20 and module #21 voltages.

Do both battery modules indicate one volt or less?

- Yes: Sense lead between modules #20 and #21 is open. Refer to 1 on this page.
- No: Does module #20 read one volt or less?
  - No: Problem intermittent; refer to Diagnostic Aids on facing pages.
  - Yes:
    - Remove battery pack.
    - Remove the top covers of the battery pack.

Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.

Was connection ok?

- No: Replace cable and tighten to proper torque.
- Yes: Using a DVOM measure the voltage of module #20.

Is module voltage 1.0 volt or less?

- Yes: Replace battery module.
- No:

1.
- Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
- Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)

Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)

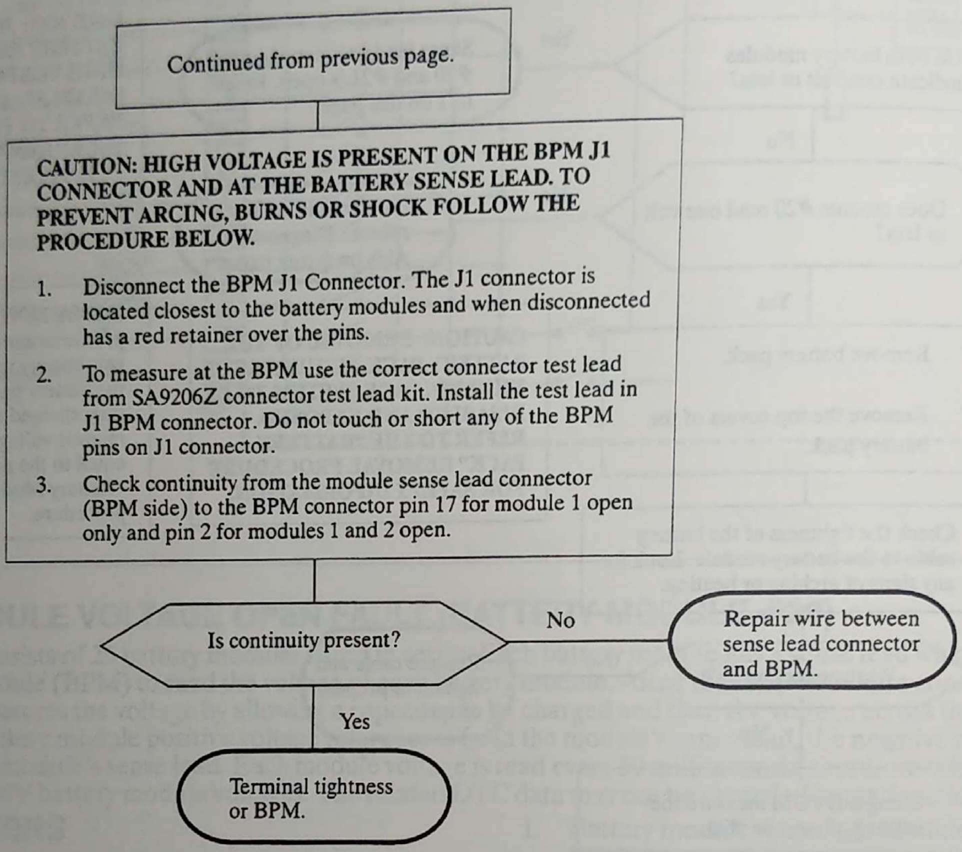
- No: Replace cable with sense lead.
- Yes: Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 153
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #20) – CONTINUED



Continued from previous page.

CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

Is continuity present?

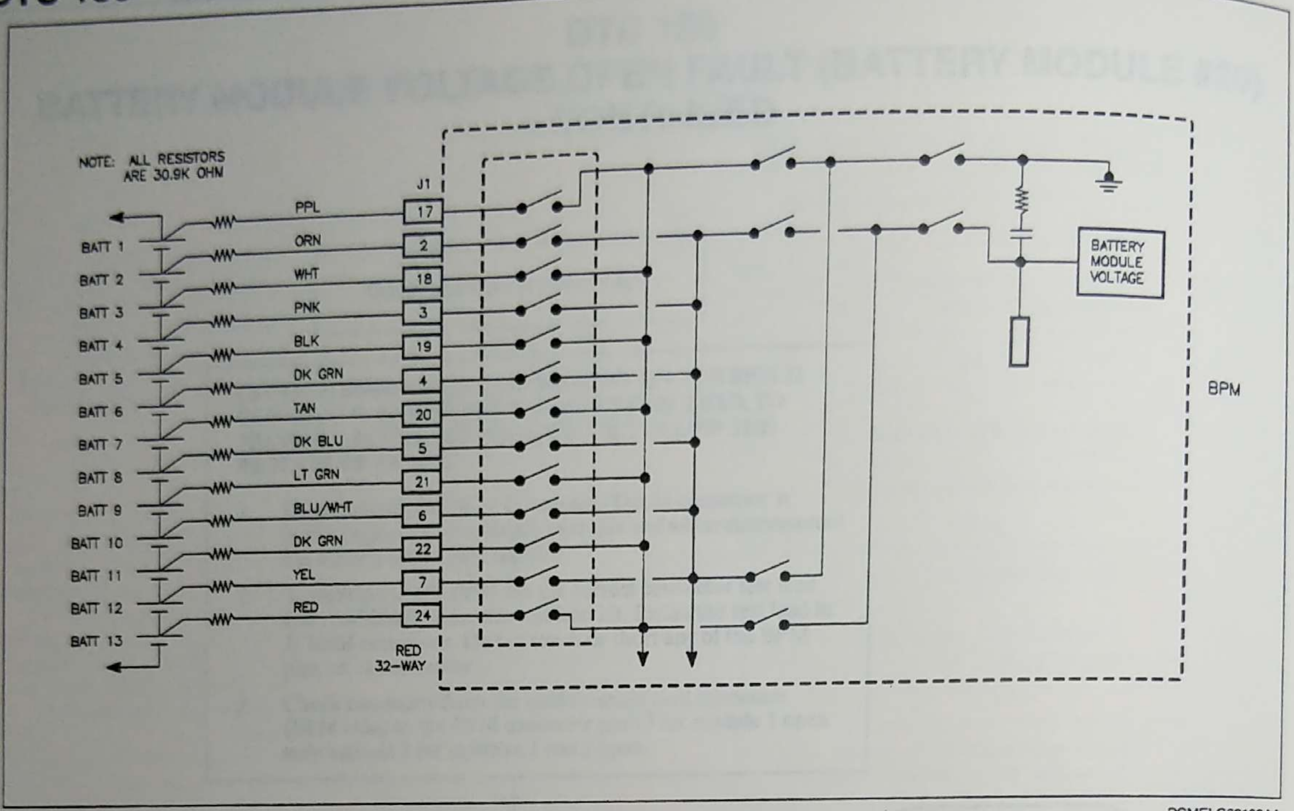
No: Repair wire between sense lead connector and BPM.

Yes: Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 155 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #20)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #20: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

None

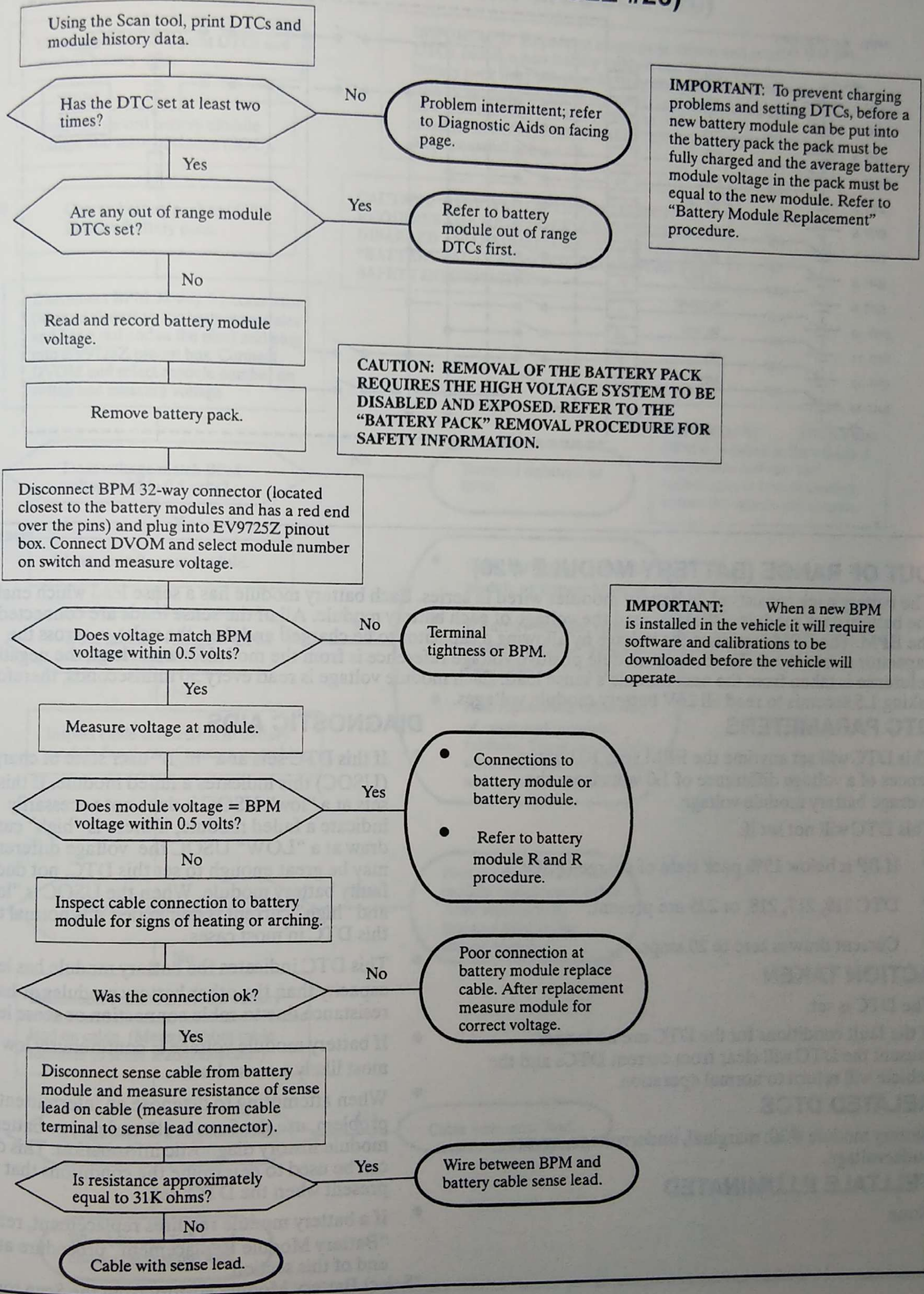
DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

CS CamScanner

DTC 155
MARGINAL (BATTERY MODULE #20)

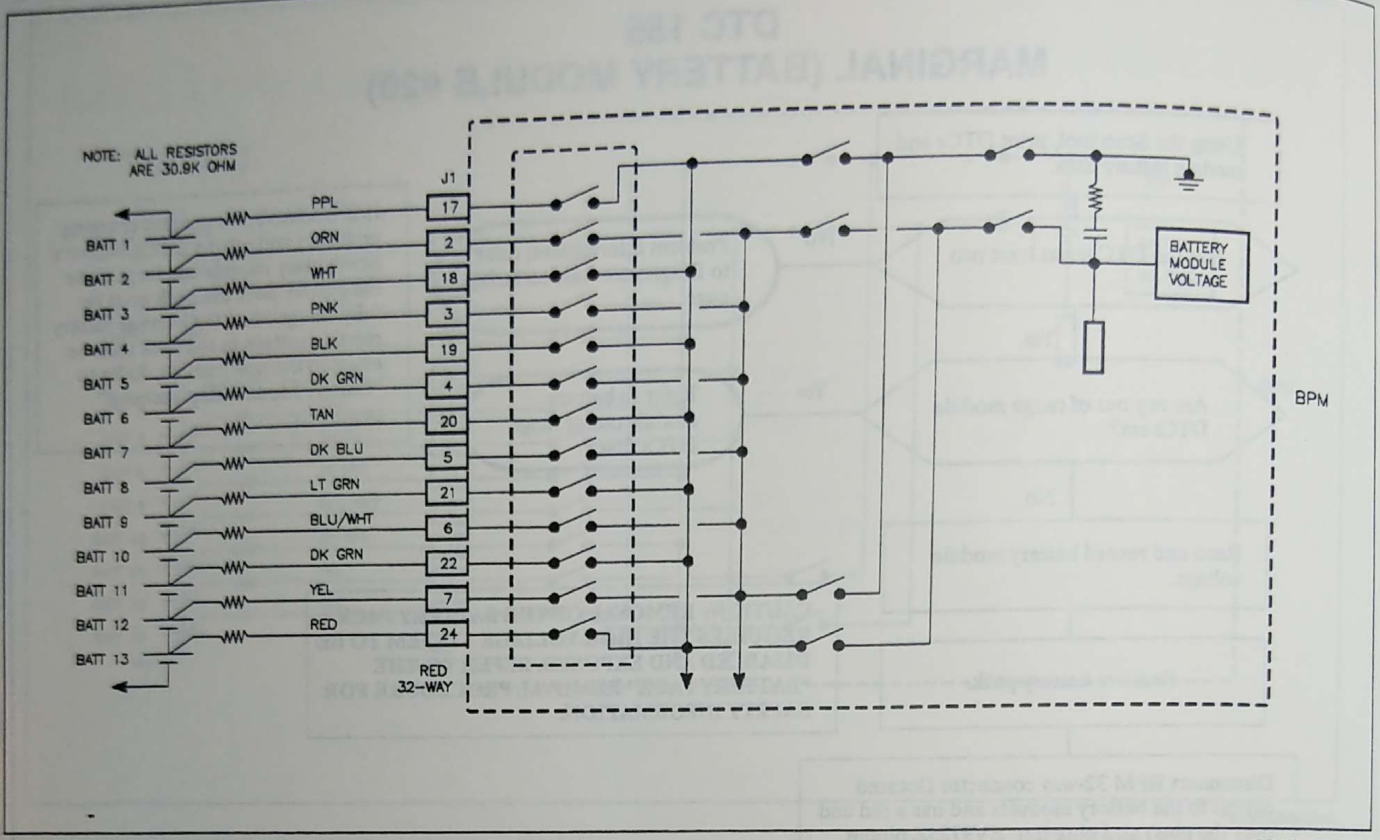

Using the Scan tool, print DTCs and module history data.
Has the DTC set at least two times?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any out of range module DTCs set?
Yes
Refer to battery module out of range DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Connections to battery module or battery module.
• Refer to battery module R and R procedure.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).
Is resistance approximately equal to 31K ohms?
Yes
Wire between BPM and battery cable sense lead.
No
Cable with sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 156 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #20)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #20: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

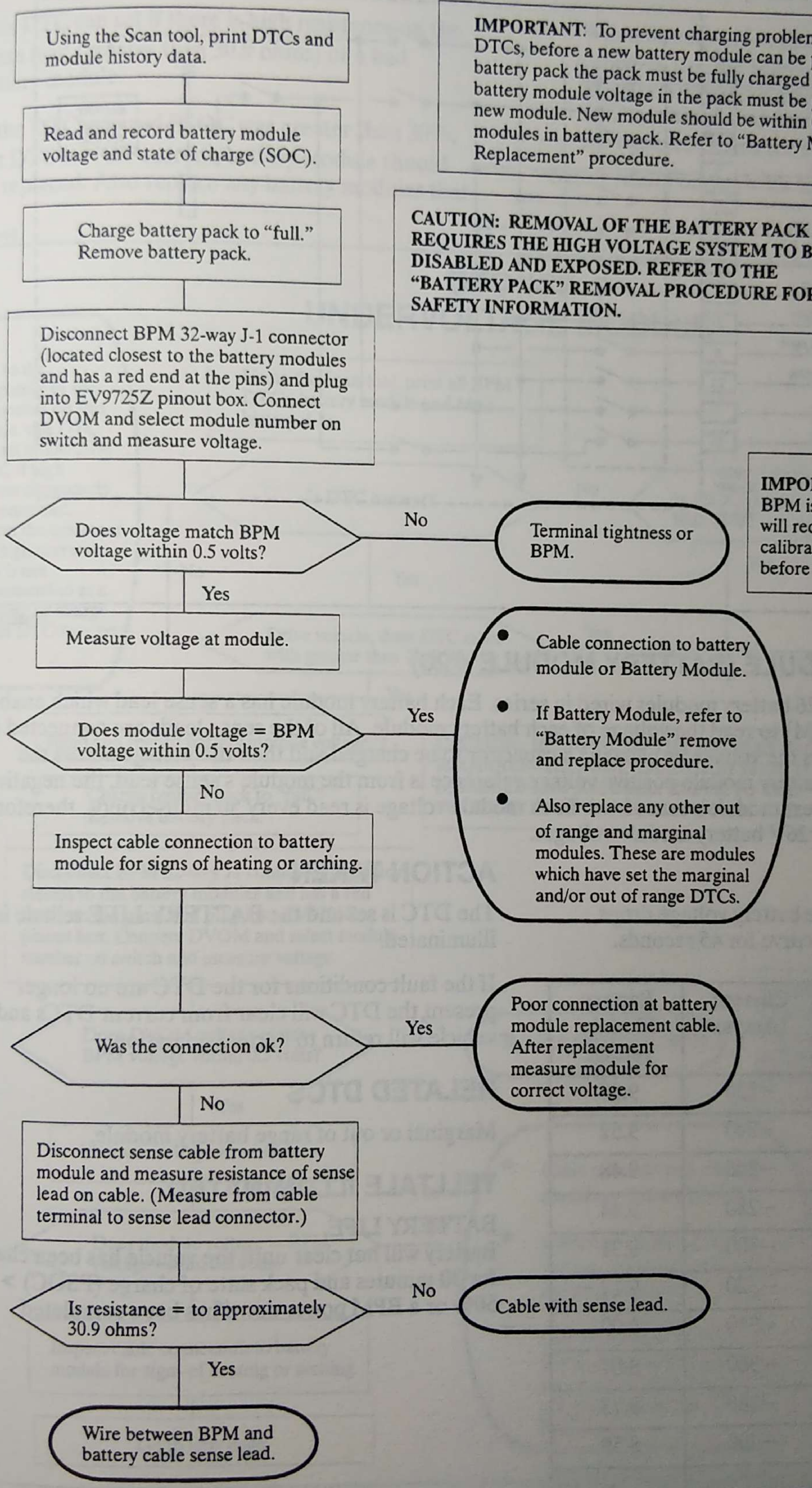
*Select Battery Module History from the Scan tool BPM menu.

DTC 156
OUT OF RANGE (BATTERY MODULE #20)

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.



Using the Scan tool, print DTCs and module history data.

Read and record battery module voltage and state of charge (SOC).

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Cable connection to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Poor connection at battery module replacement cable. After replacement measure module for correct voltage.

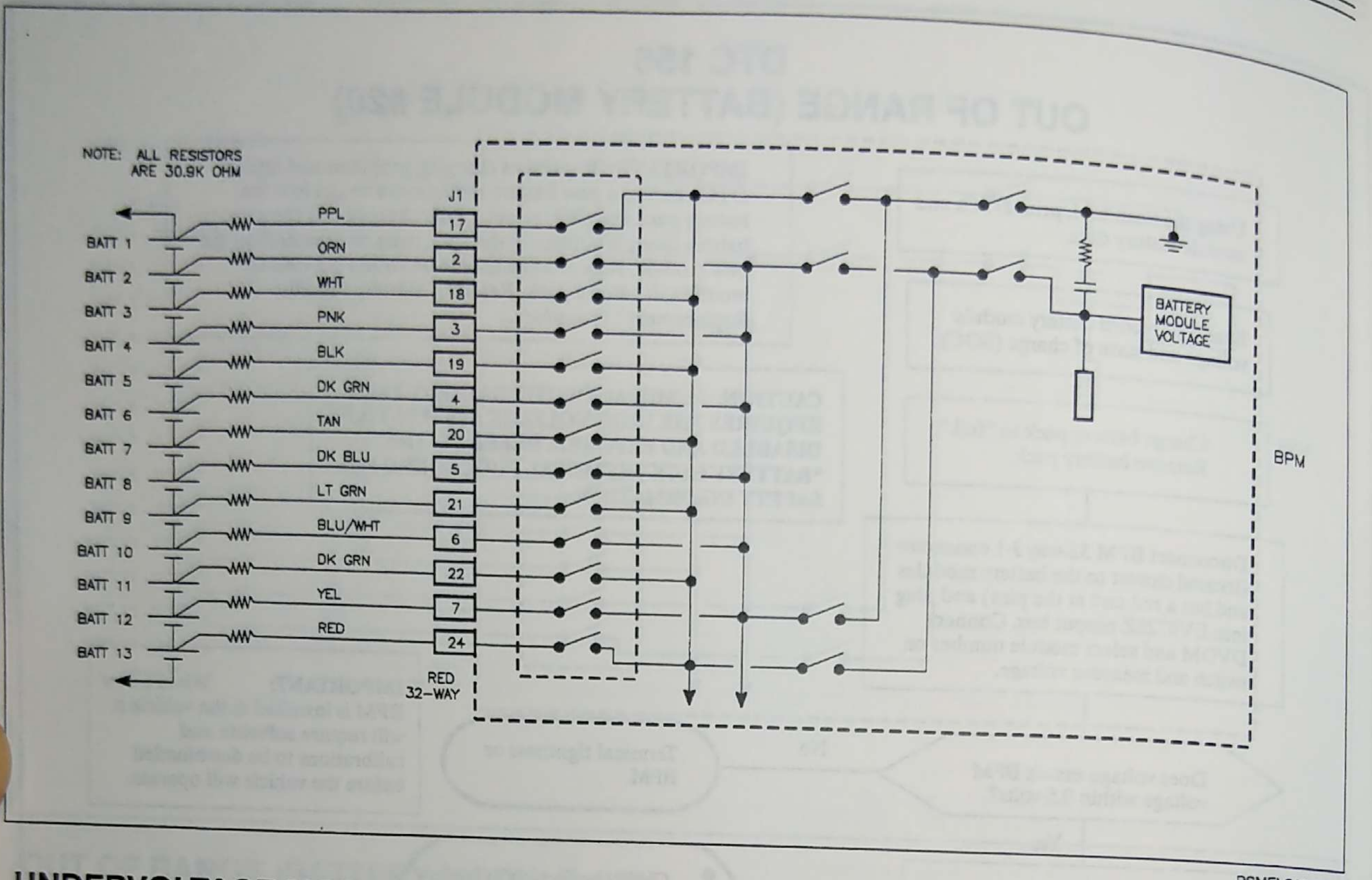
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)

Is resistance = to approximately 30.9 ohms?

Cable with sense lead.

Wire between BPM and battery cable sense lead.

DTC 157 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
J1
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32–WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #20)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage	Current (Amps)	Battery Module Voltage
0	11.75	−220	9.60
−20	11.10	−240	9.52
−40	10.90	−260	9.48
−60	10.65	−280	9.44
−80	10.45	−300	9.31
−100	10.30	−320	9.17
−120	10.15	−340	9.03
−140	10.00	−360	8.87
−160	9.90	−380	8.73
−180	9.80	−400	8.59
−200	9.70		

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

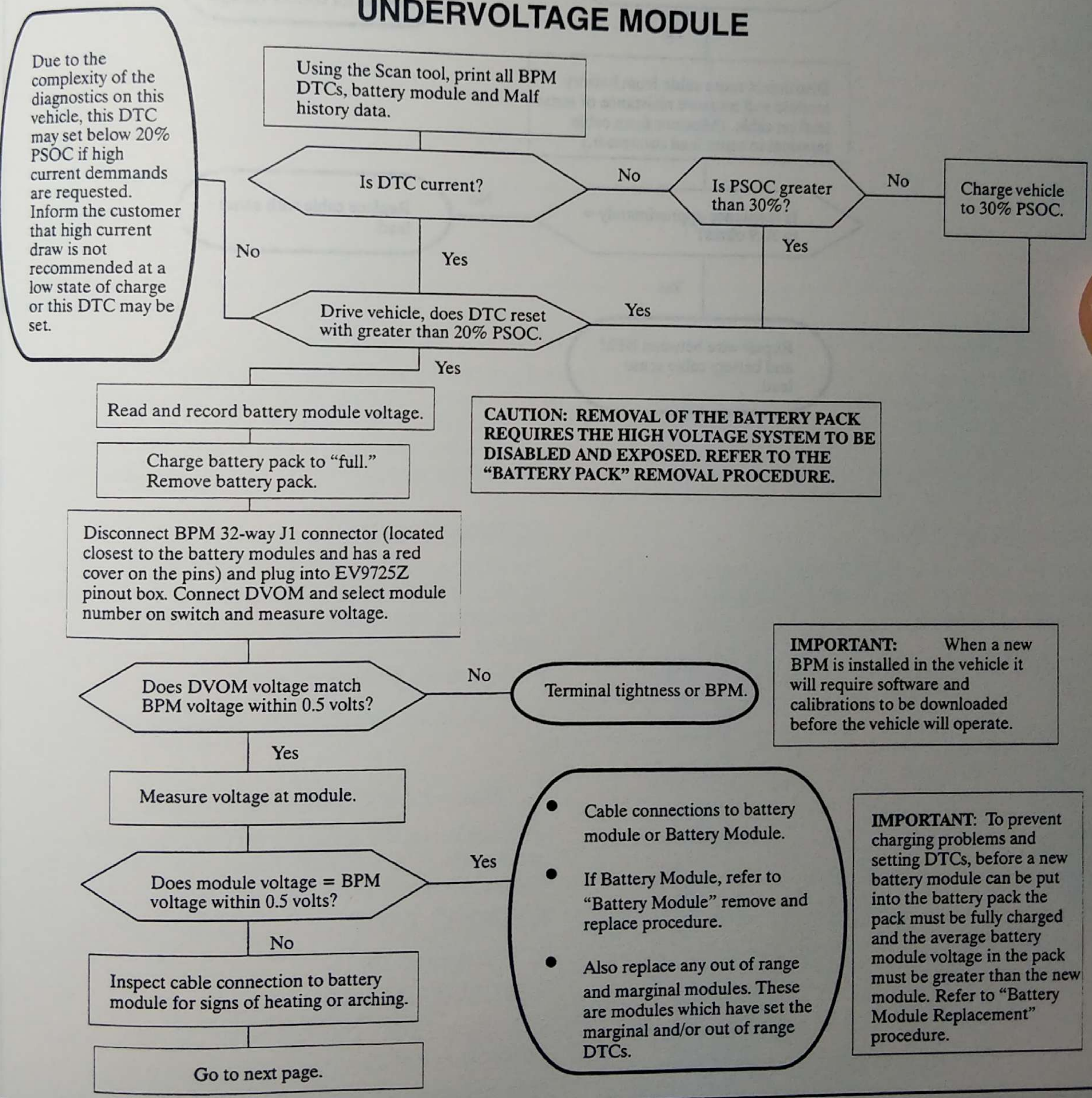
CS CamScanner

DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below zero percent user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 157
UNDERVOLTAGE MODULE

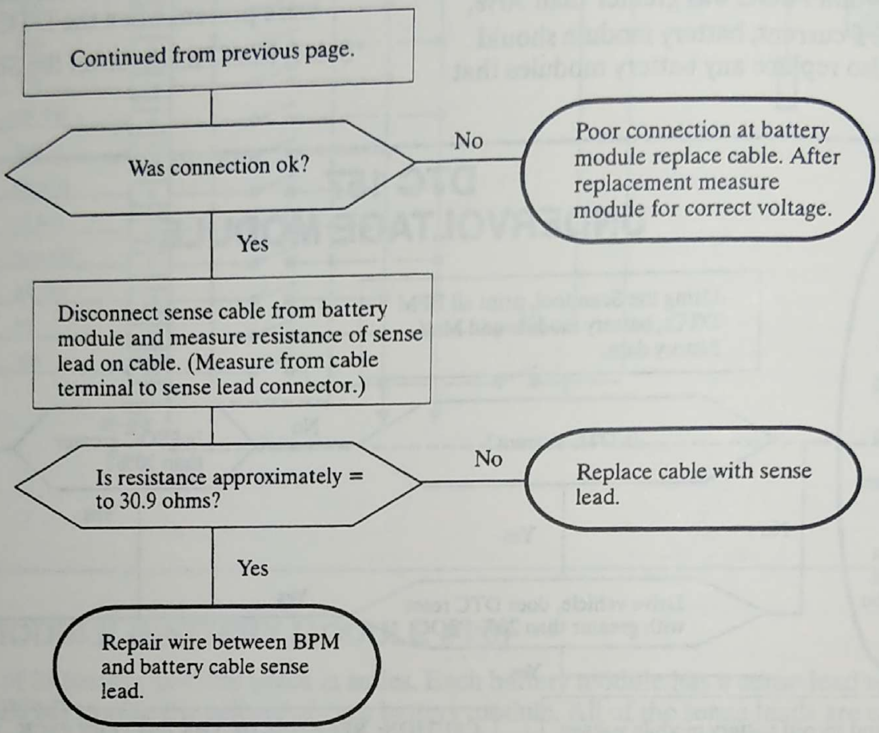

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
Yes
No
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

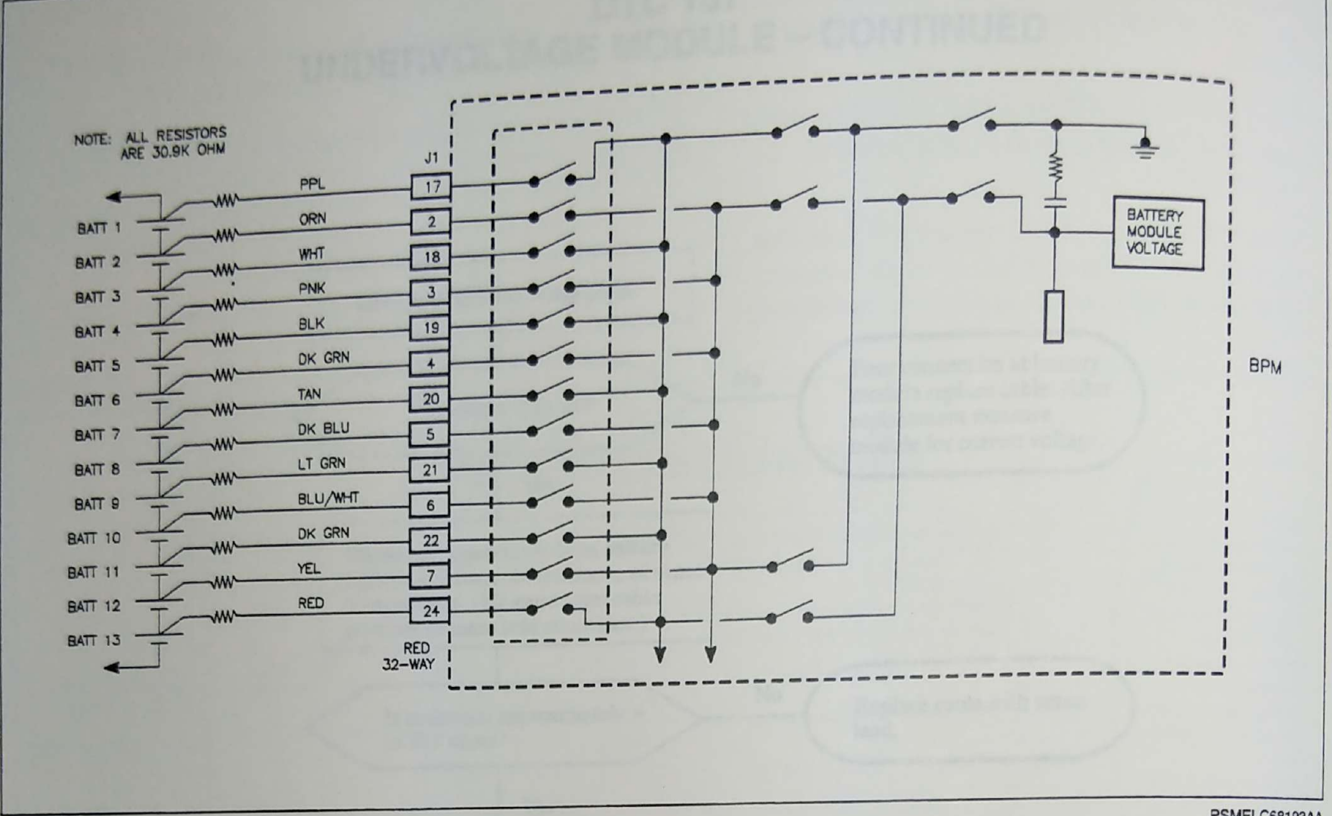
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 157
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 158 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #20)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

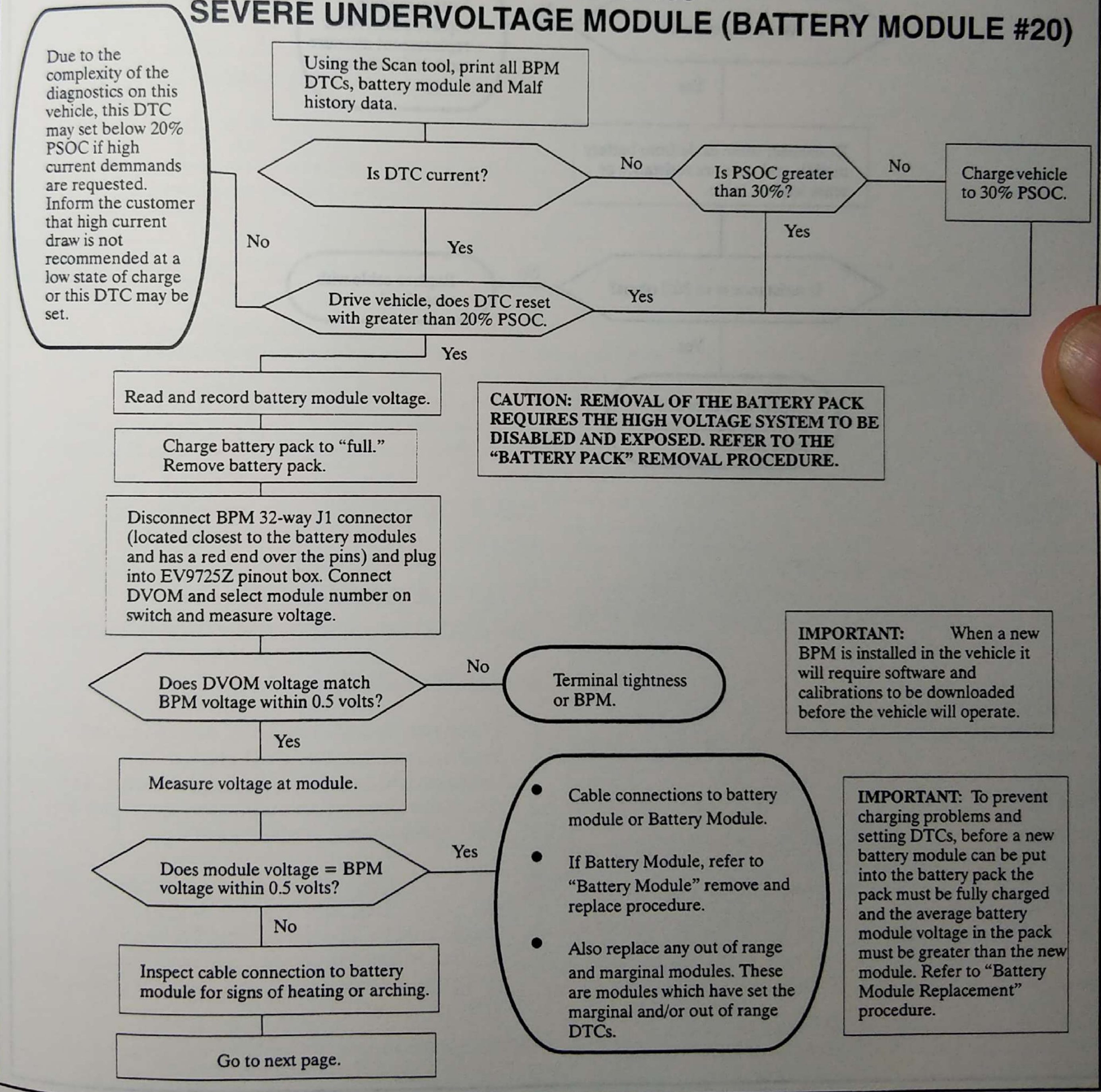
Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches zero percent user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 158
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #20)



Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

Using the Scan tool, print all BPM DTCs, battery module and Malf history data.

Is DTC current?

Is PSOC greater than 30%?

Charge vehicle to 30% PSOC.

Drive vehicle, does DTC reset with greater than 20% PSOC.

Read and record battery module voltage.

Charge battery pack to "full." Remove battery pack.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

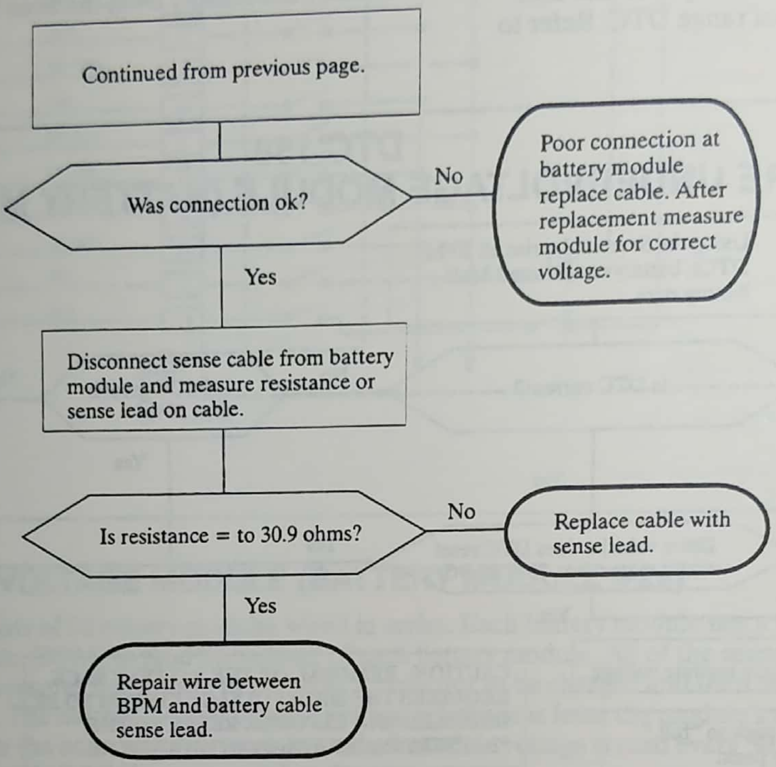
- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

Inspect cable connection to battery module for signs of heating or arching.

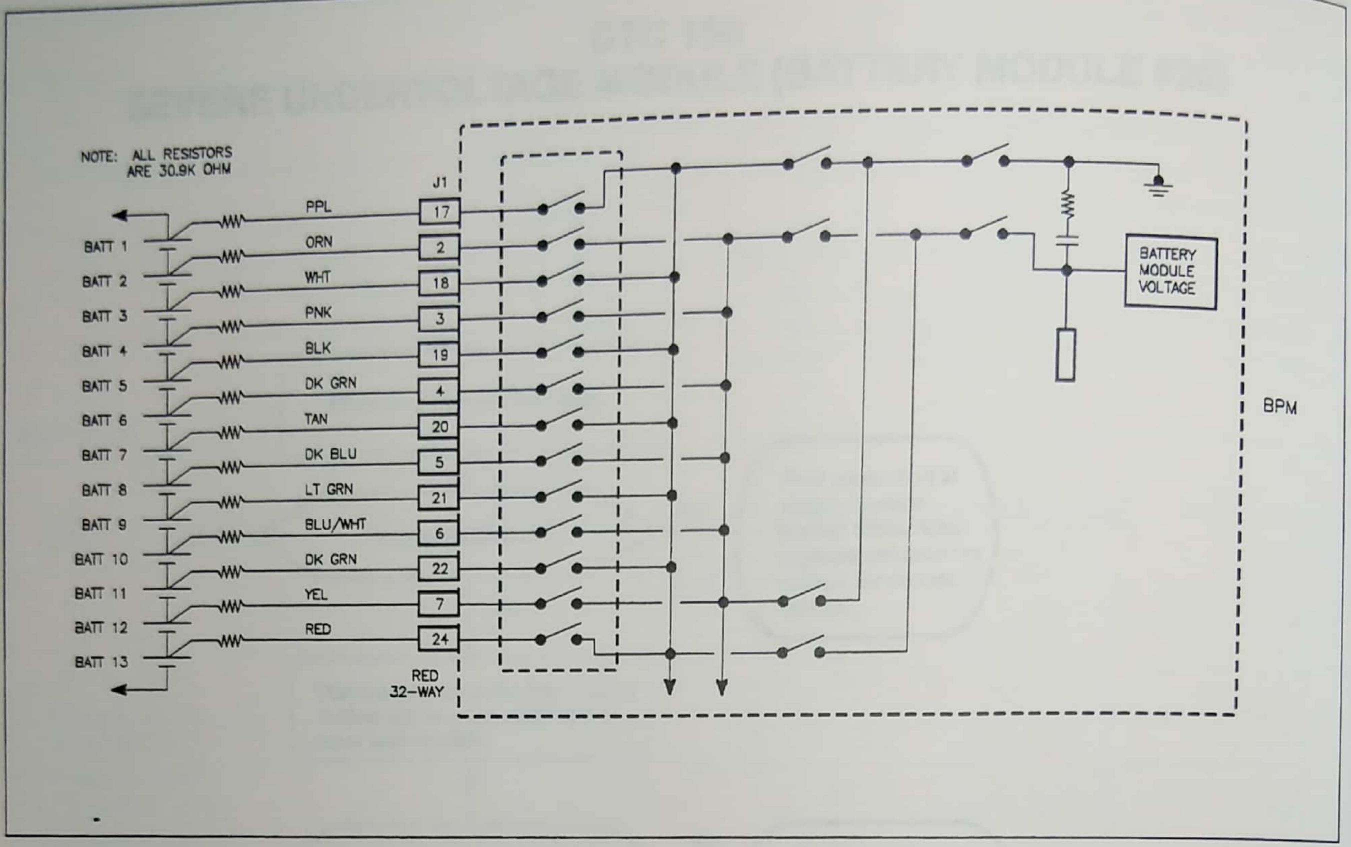
Go to next page.

DTC 158
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #20)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 159 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #20)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

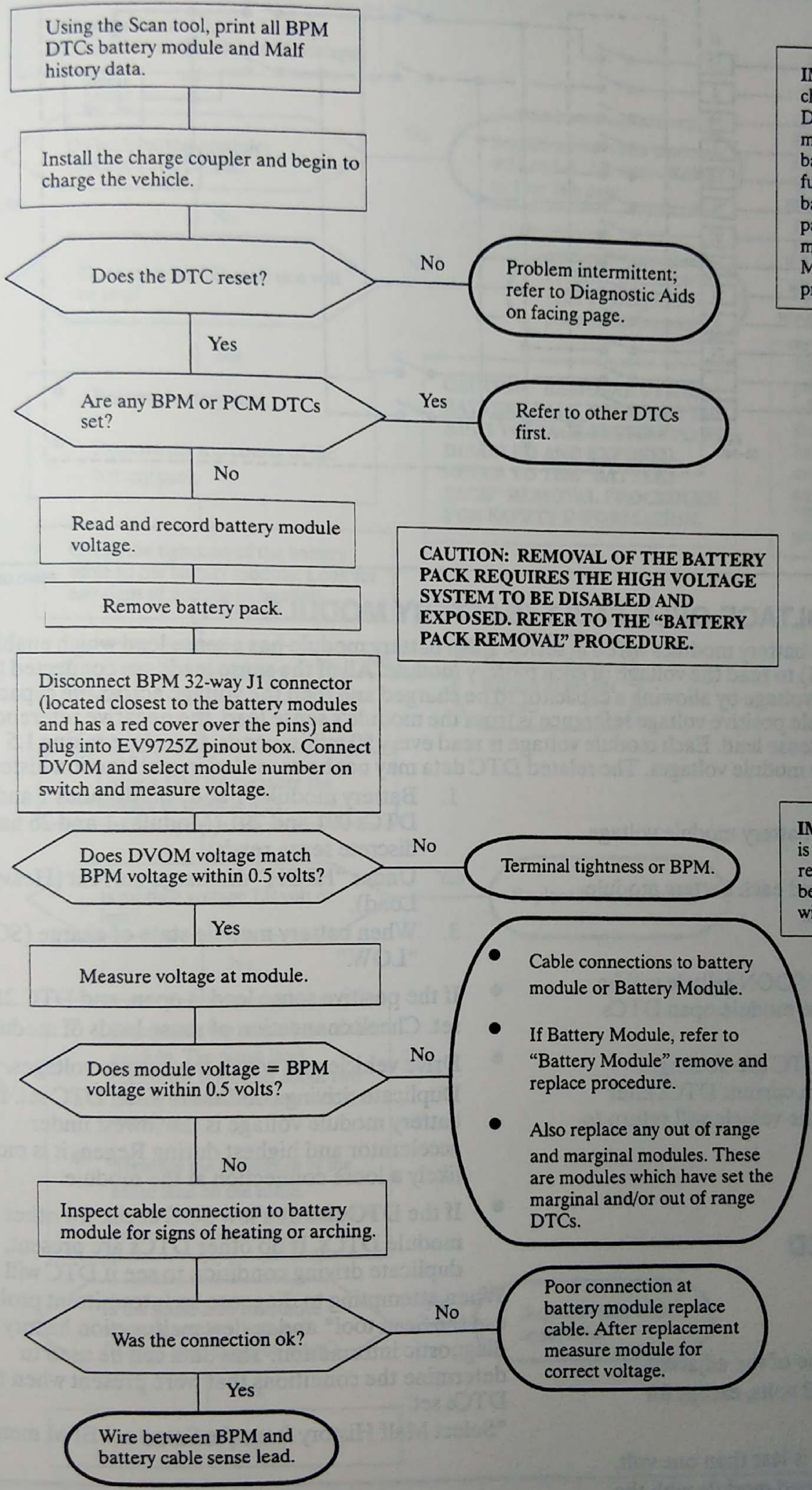
SERVICE NOW and REDUCED PERFORMANCE

DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

DTC 159
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #20)



Using the Scan tool, print all BPM DTCs battery module and Malf history data.

Install the charge coupler and begin to charge the vehicle.

Does the DTC reset?

No: Problem intermittent; refer to Diagnostic Aids on facing page.

Yes: Are any BPM or PCM DTCs set?

Yes: Refer to other DTCs first.

No: Read and record battery module voltage.

Remove battery pack.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

No: Terminal tightness or BPM.

Yes: Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

No:

- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

No: Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

No: Poor connection at battery module replace cable. After replacement measure module for correct voltage.

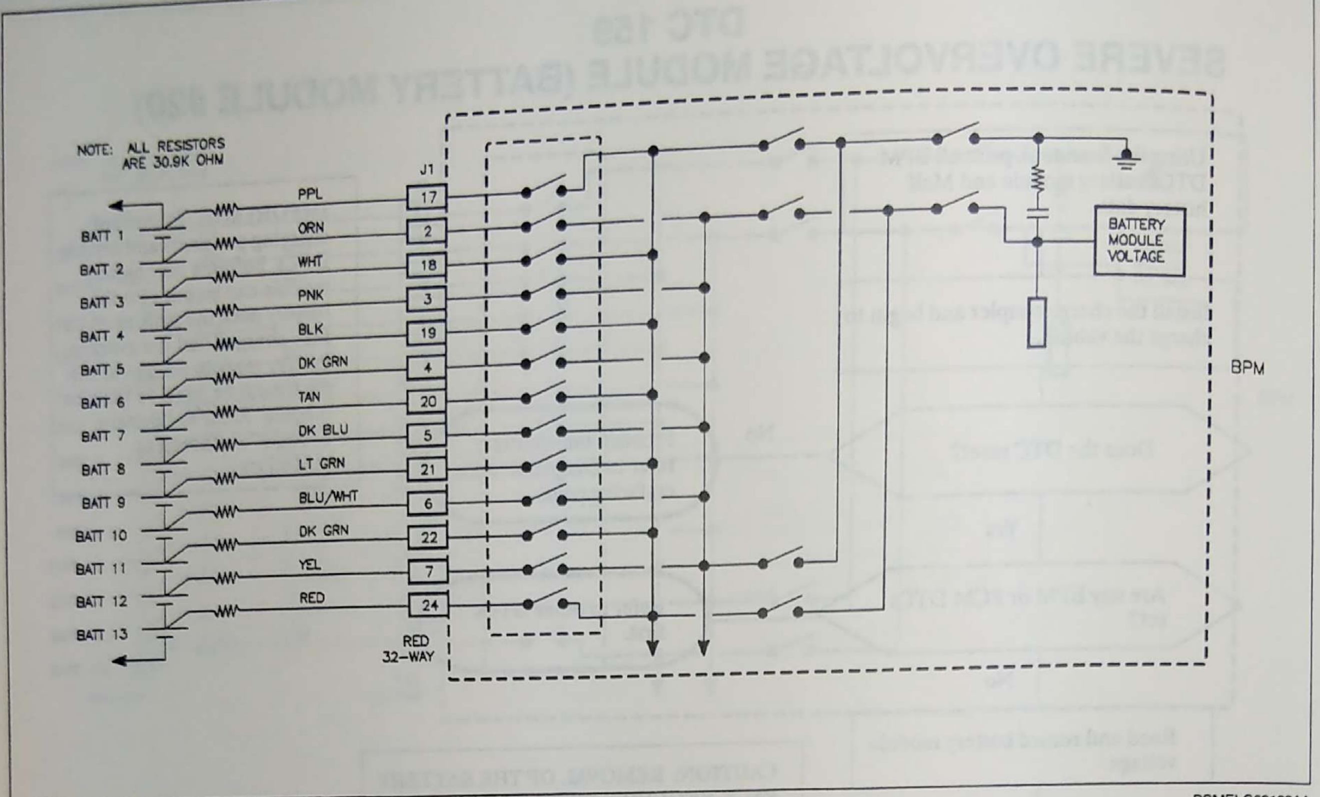
Yes: Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 161 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #21)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

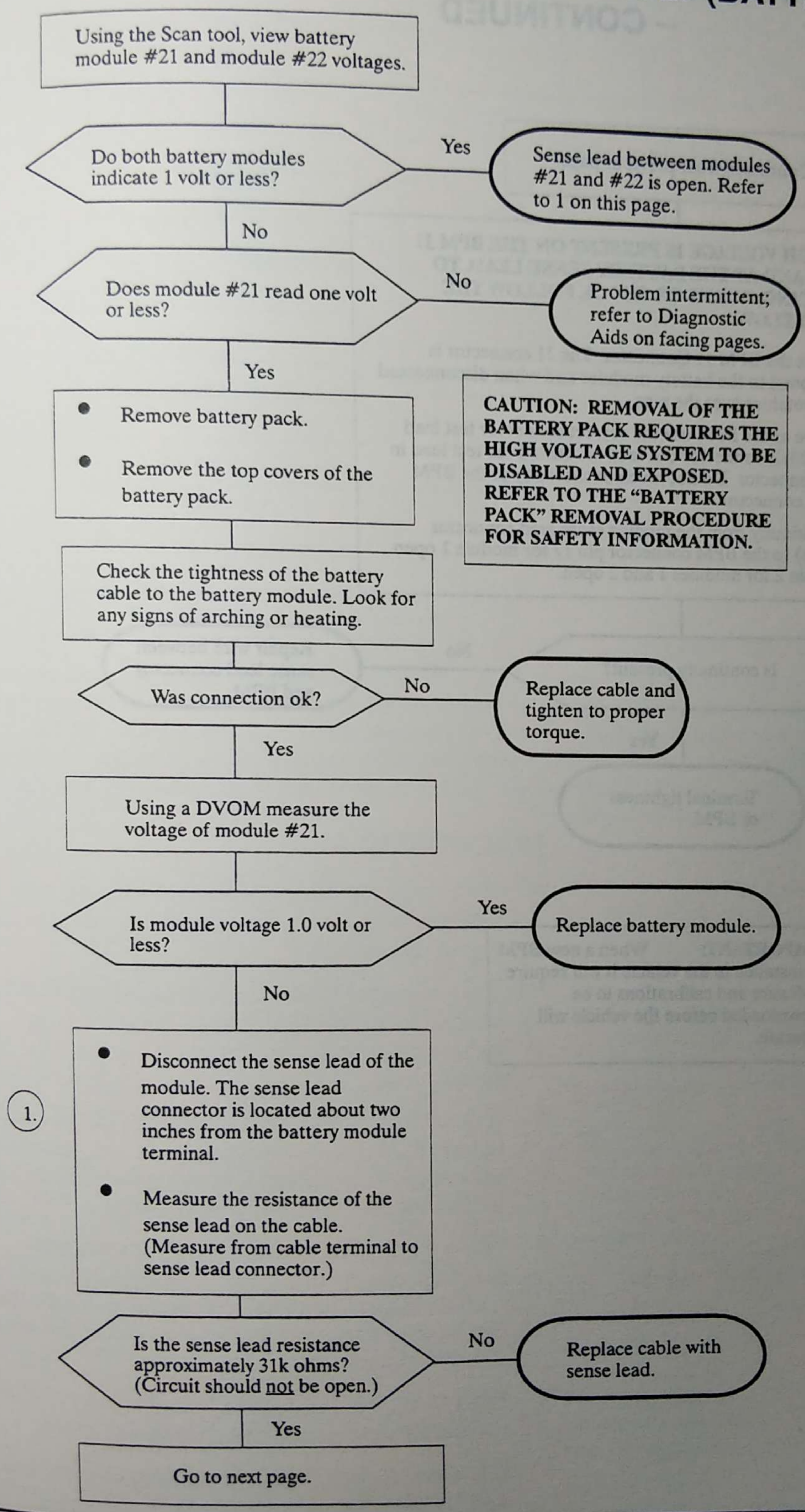
DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:
  1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
  2. Under "HIGH" discharge current (Heavy Load).
  3. When battery module state of charge (SOC) is "LOW."
- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 161
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #21)

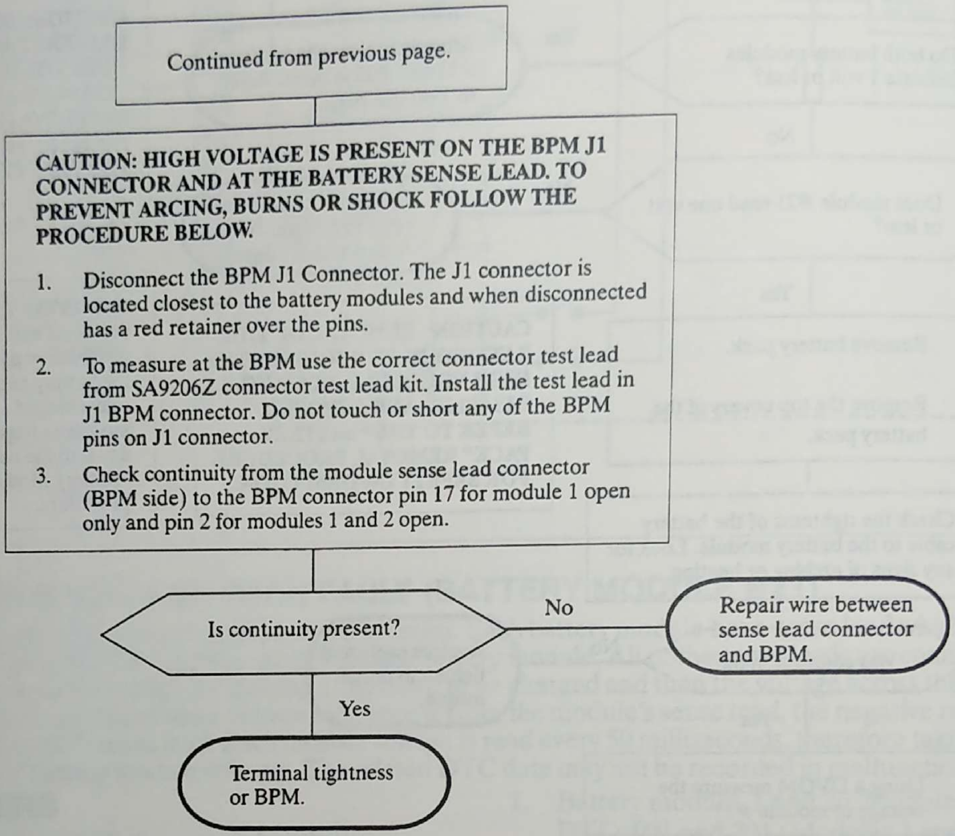

Using the Scan tool, view battery module #21 and module #22 voltages.
Do both battery modules indicate 1 volt or less?
Yes
Sense lead between modules #21 and #22 is open. Refer to 1 on this page.
No
Does module #21 read one volt or less?
No
Problem intermittent; refer to Diagnostic Aids on facing pages.
Yes
Remove battery pack.
Remove the top covers of the battery pack.
Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.
Was connection ok?
No
Replace cable and tighten to proper torque.
Yes
Using a DVOM measure the voltage of module #21.
Is module voltage 1.0 volt or less?
Yes
Replace battery module.
No
1.
Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)
Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)
No
Replace cable with sense lead.
Yes
Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 161
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #21) – CONTINUED


Continued from previous page.
Is continuity present?
No
Repair wire between sense lead connector and BPM.
Yes
Terminal tightness or BPM.

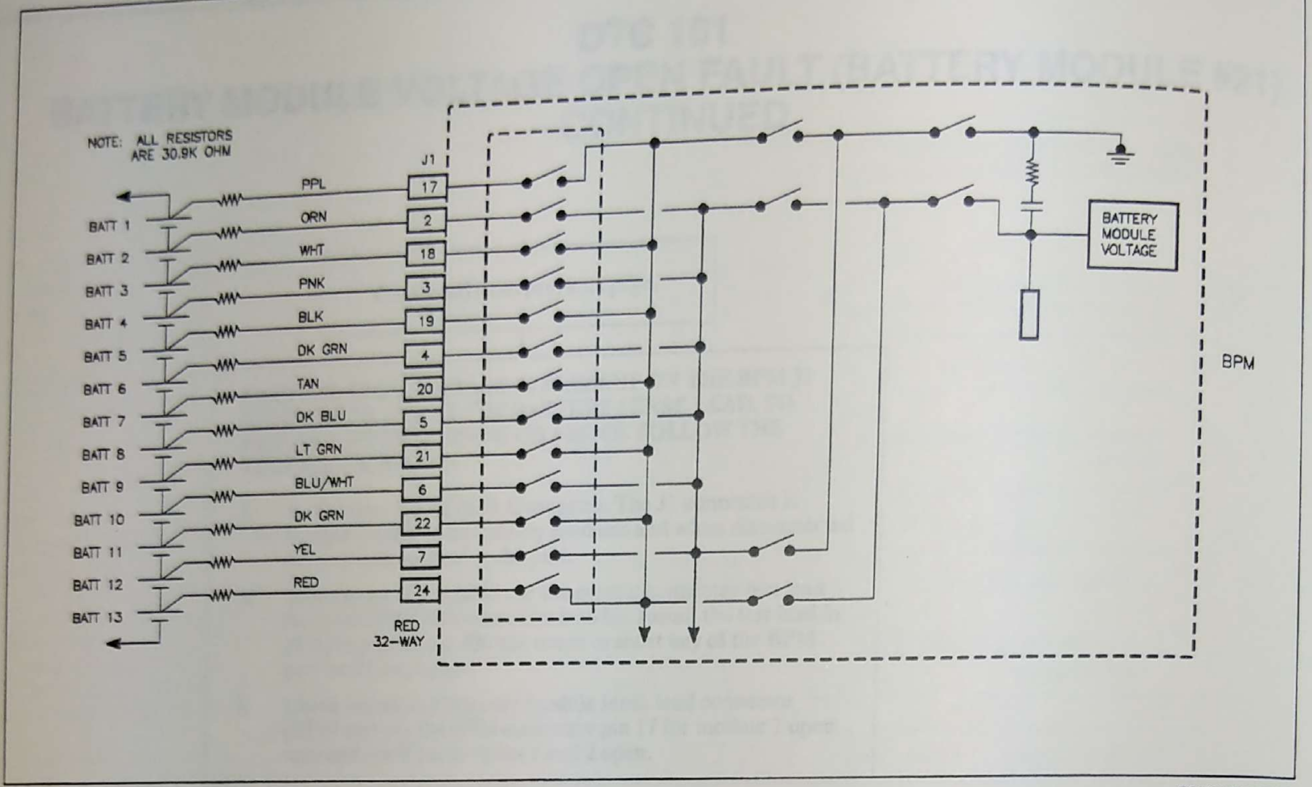
CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 163 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #21)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #21: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

None

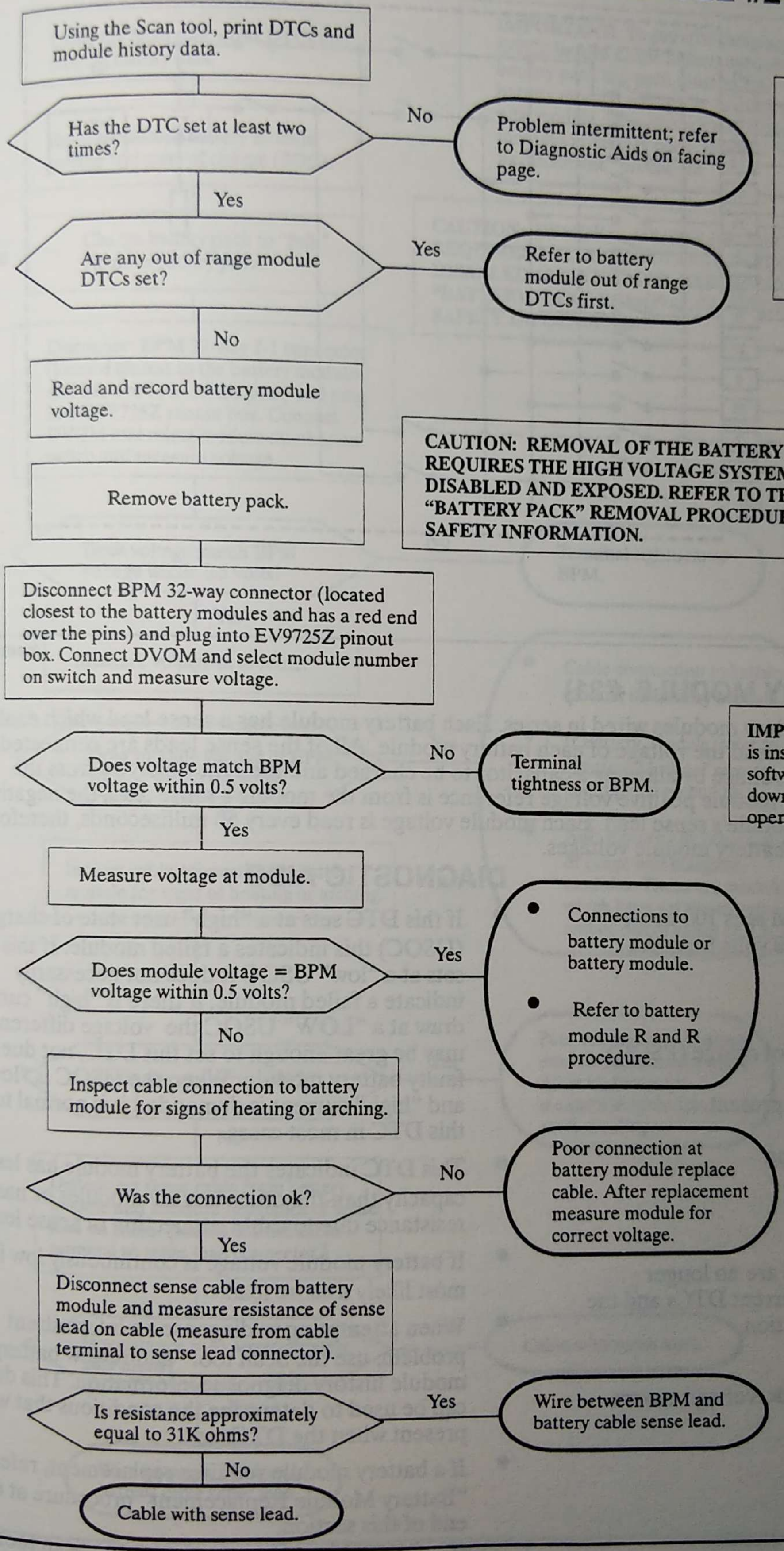
DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

CS CamScanner

DTC 163
MARGINAL (BATTERY MODULE #21)



Using the Scan tool, print DTCs and module history data.

Has the DTC set at least two times?

No: Problem intermittent; refer to Diagnostic Aids on facing page.

Yes: Are any out of range module DTCs set?

Yes: Refer to battery module out of range DTCs first.

No: Read and record battery module voltage.

Remove battery pack.

Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

No: Terminal tightness or BPM.

Yes: Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

Yes:
- Connections to battery module or battery module.
- Refer to battery module R and R procedure.

No: Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

No: Poor connection at battery module replace cable. After replacement measure module for correct voltage.

Yes: Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).

Is resistance approximately equal to 31K ohms?

Yes: Wire between BPM and battery cable sense lead.

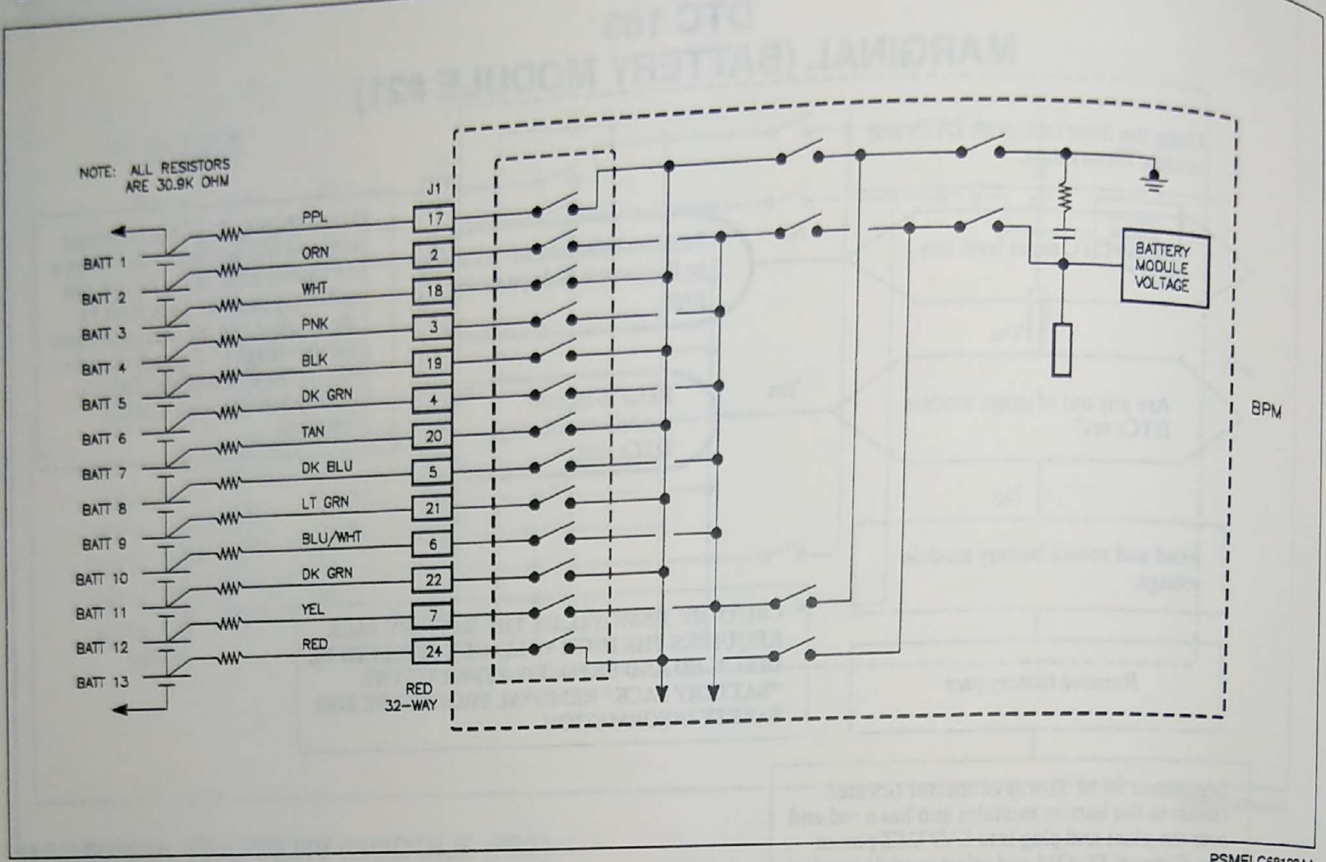
No: Cable with sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 164 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #21)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #21: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

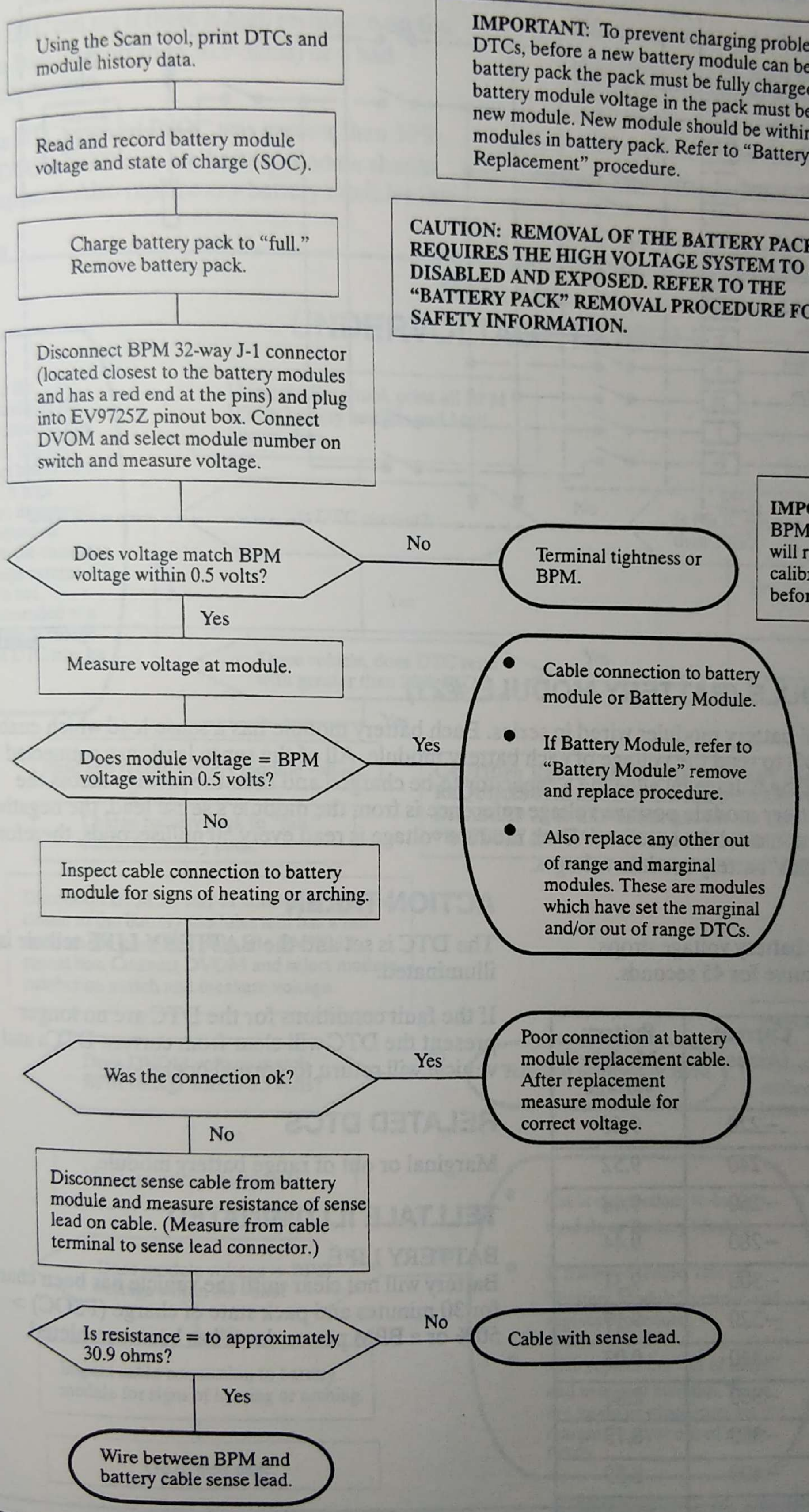
- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

*Select Battery Module History from the Scan tool BPM menu.

DTC 164
OUT OF RANGE (BATTERY MODULE #21)

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.



Using the Scan tool, print DTCs and module history data.

Read and record battery module voltage and state of charge (SOC).

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

No: Terminal tightness or BPM.

Yes: Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

Yes:

- Cable connection to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

No: Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Yes: Poor connection at battery module replacement cable. After replacement measure module for correct voltage.

No: Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)

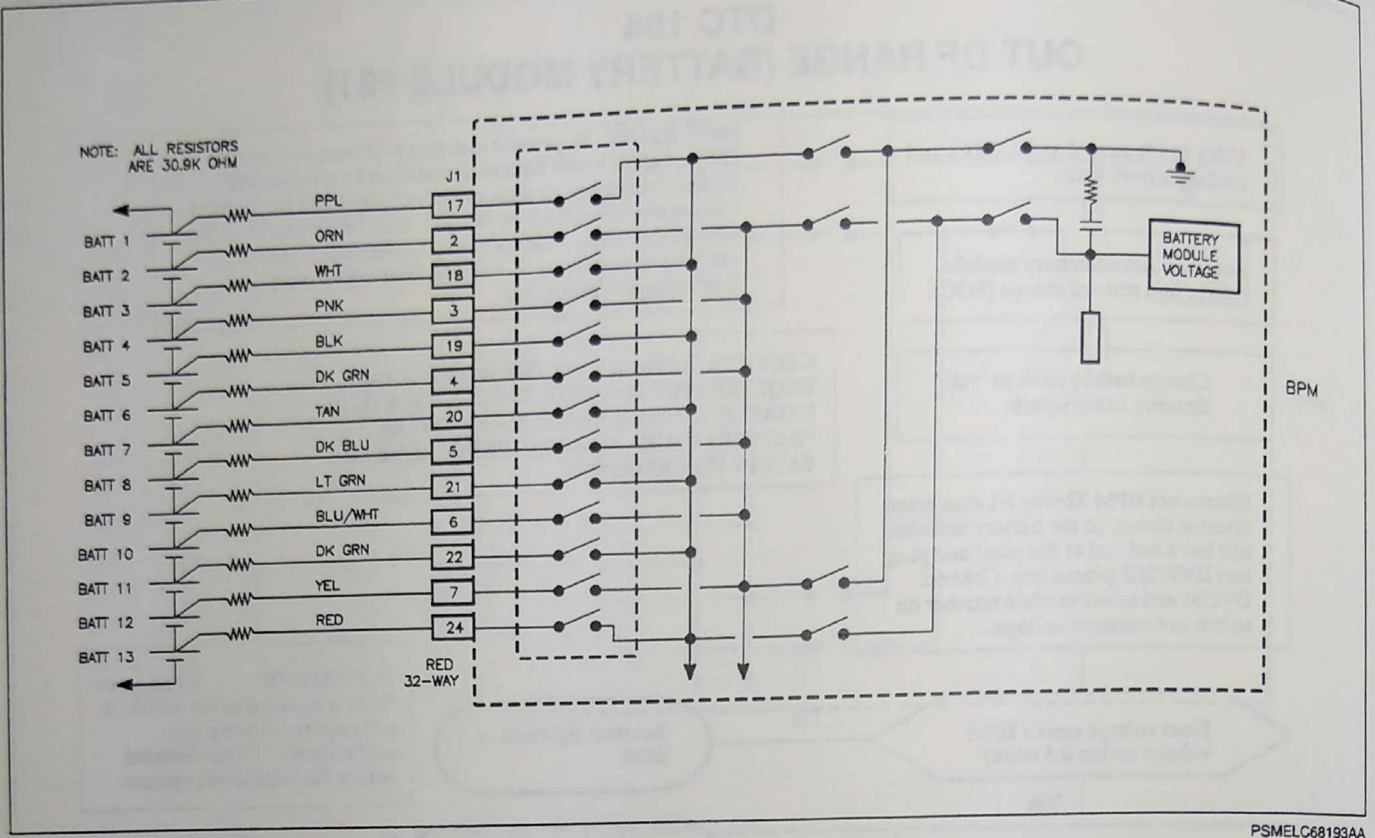
Is resistance = to approximately 30.9 ohms?

No: Cable with sense lead.

Yes: Wire between BPM and battery cable sense lead.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 165 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #21)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage	Current (Amps)	Battery Module Voltage
0	11.75	−220	9.60
−20	11.10	−240	9.52
−40	10.90	−260	9.48
−60	10.65	−280	9.44
−80	10.45	−300	9.31
−100	10.30	−320	9.17
−120	10.15	−340	9.03
−140	10.00	−360	8.87
−160	9.90	−380	8.73
−180	9.80	−400	8.59
−200	9.70		

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

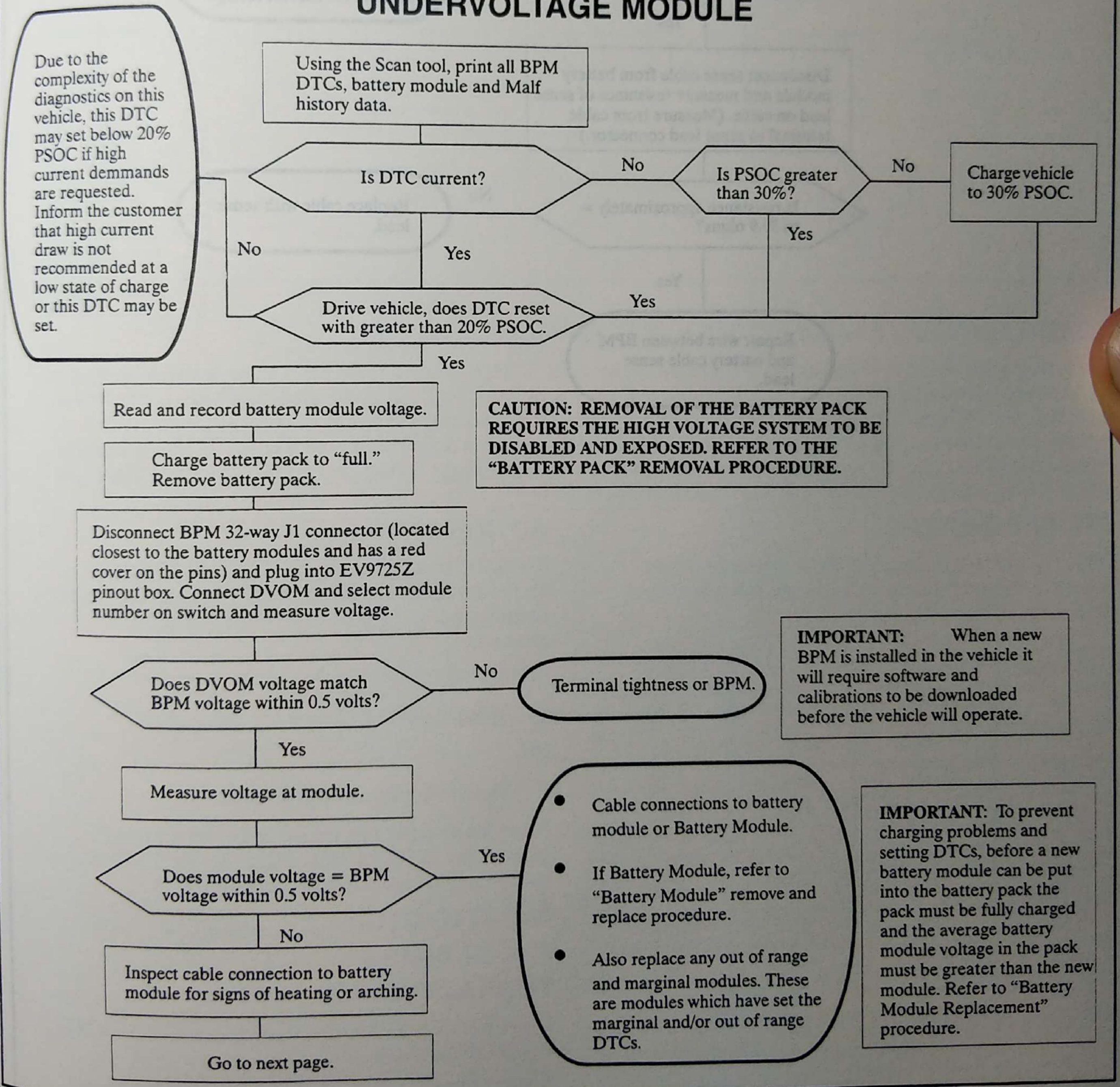
BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below zero percent user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 165
UNDERVOLTAGE MODULE

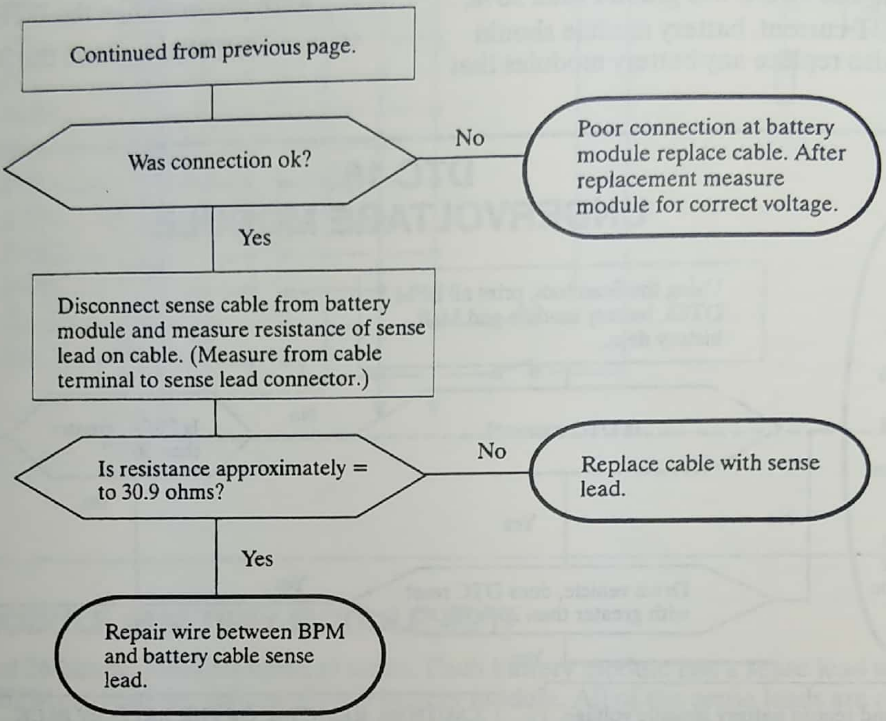

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
Cable connections to battery module or Battery Module.
If Battery Module, refer to "Battery Module" remove and replace procedure.
Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

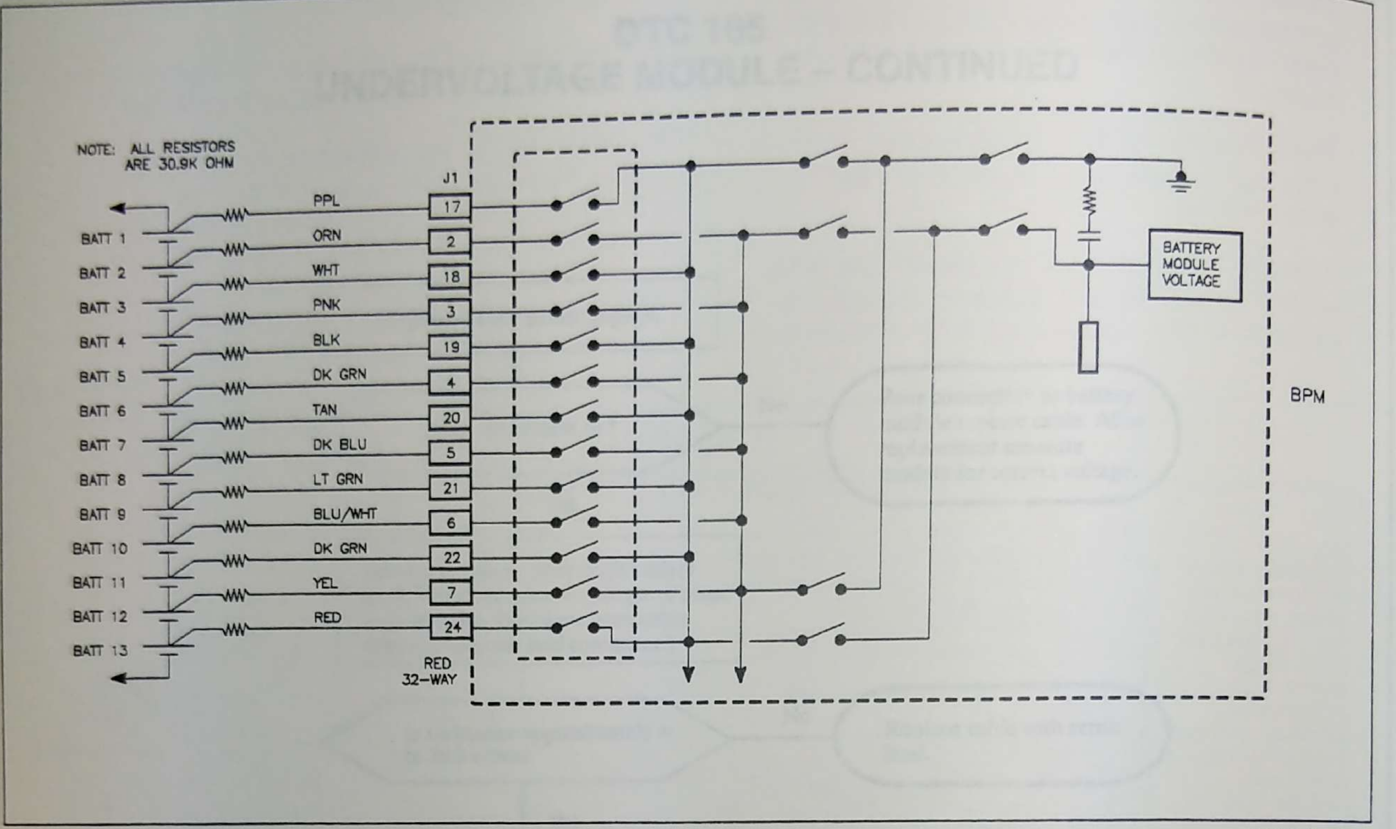
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 165
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 166 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
J1
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32–WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #21)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

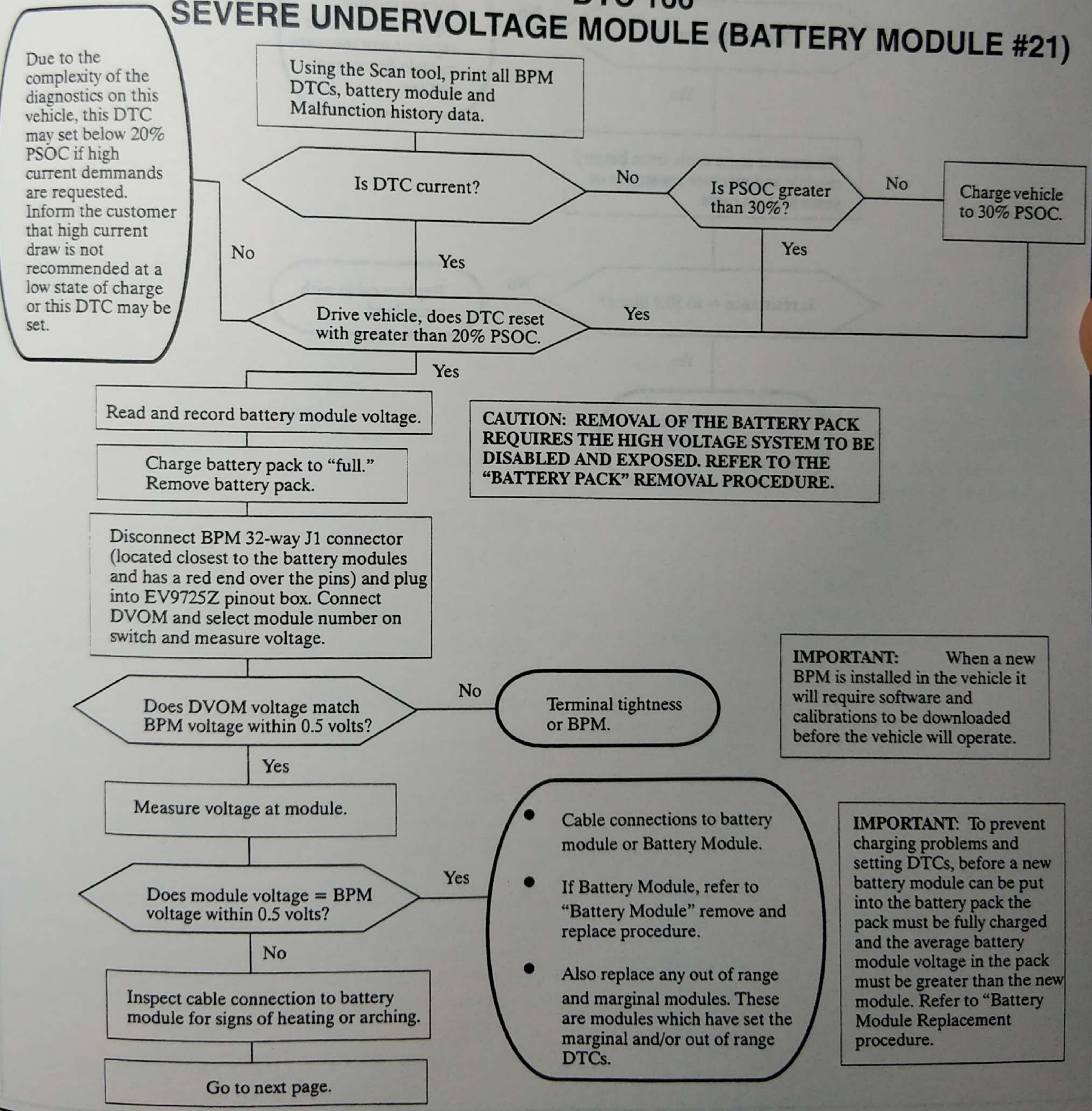
Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches zero percent user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 166
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #21)

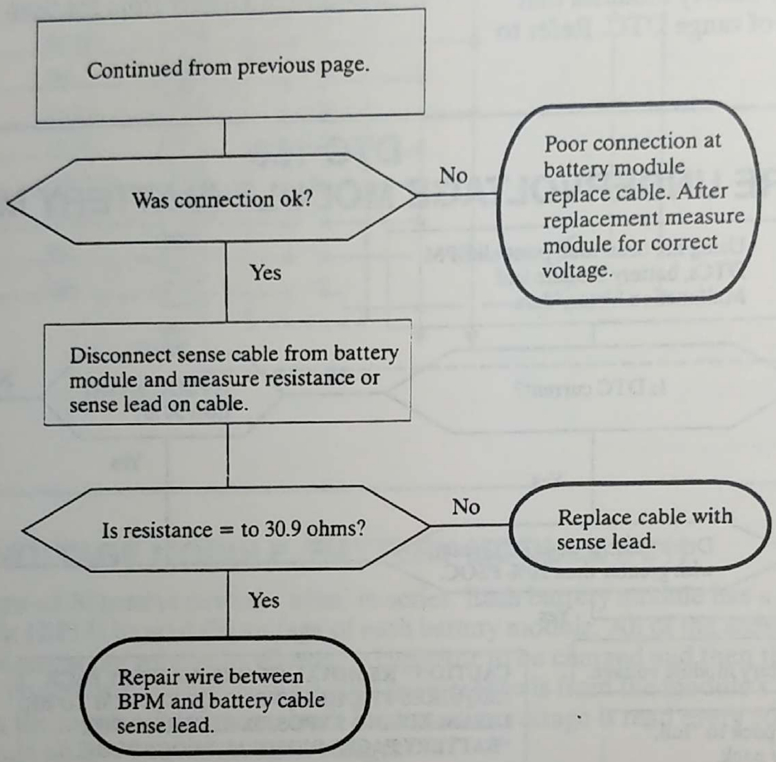

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malfunction history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
Yes
No
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

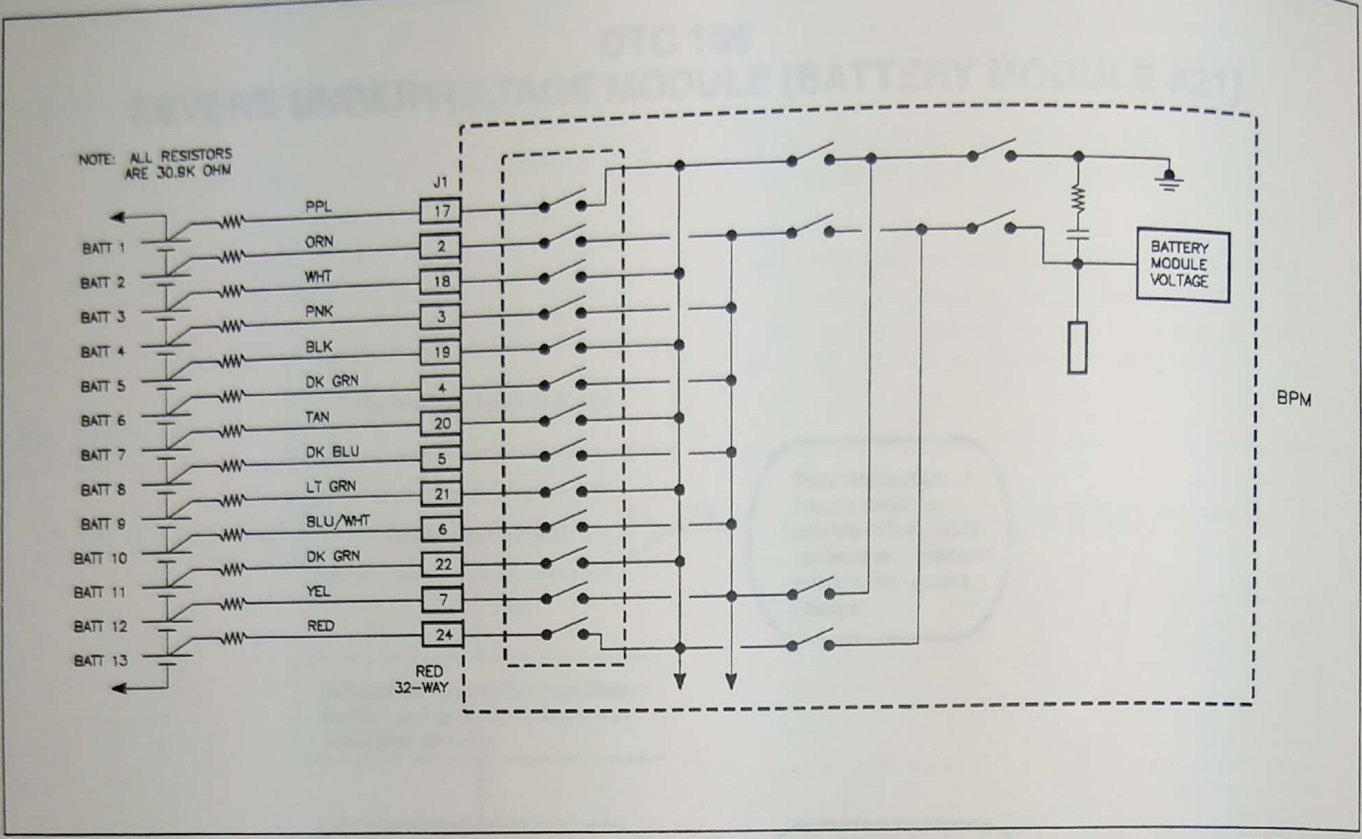
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement procedure.

DTC 166
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #21)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 167 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #21)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

SERVICE NOW and REDUCED PERFORMANCE

DIAGNOSTIC AIDS

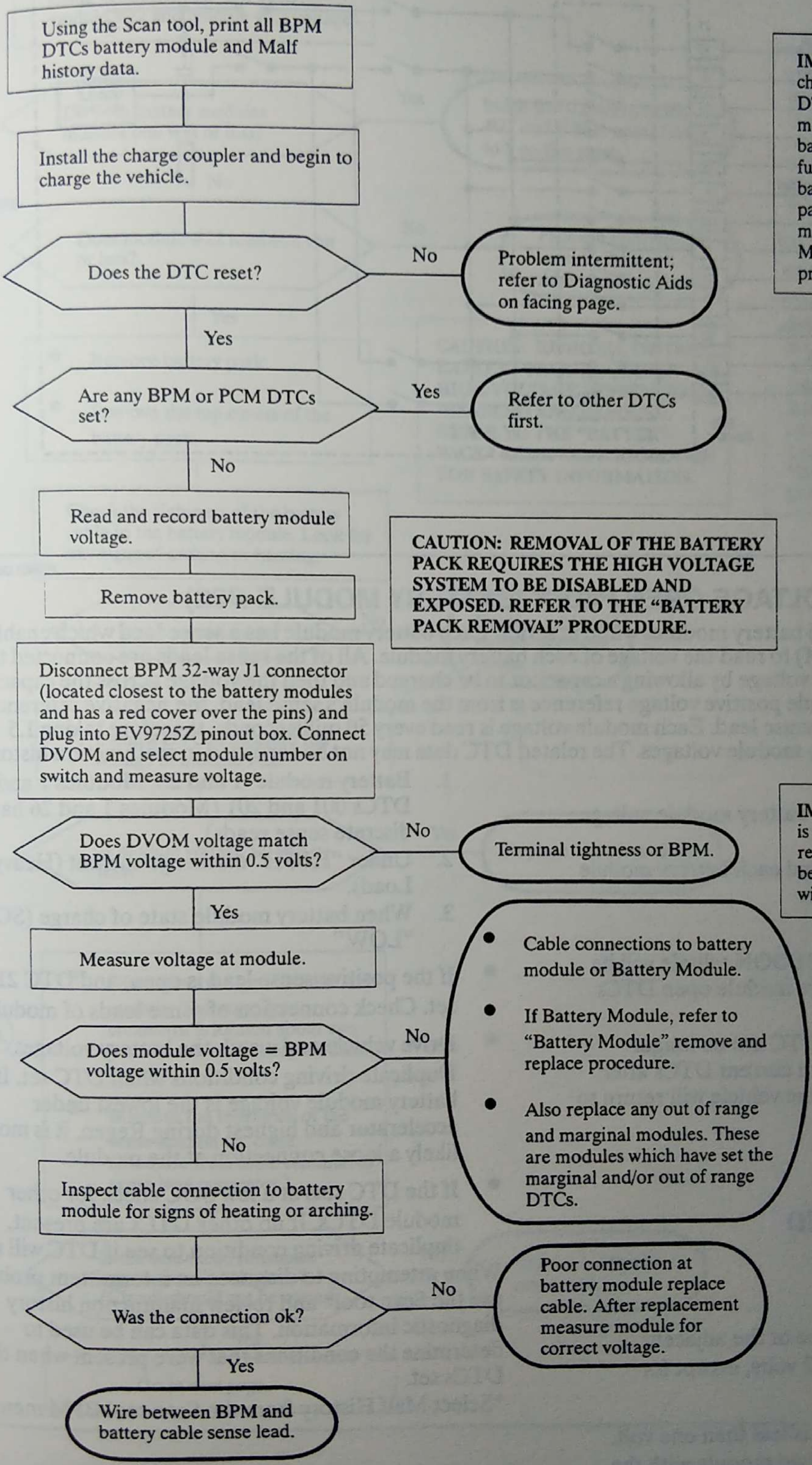
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

DTC 167
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #21)

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.



Using the Scan tool, print all BPM DTCs battery module and Malf history data.

Install the charge coupler and begin to charge the vehicle.

Does the DTC reset?

No: Problem intermittent; refer to Diagnostic Aids on facing page.

Yes: Are any BPM or PCM DTCs set?

Yes: Refer to other DTCs first.

No: Read and record battery module voltage.

Remove battery pack.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

No: Terminal tightness or BPM.

Yes: Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

No:
- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

No: Inspect cable connection to battery module for signs of heating or arching.

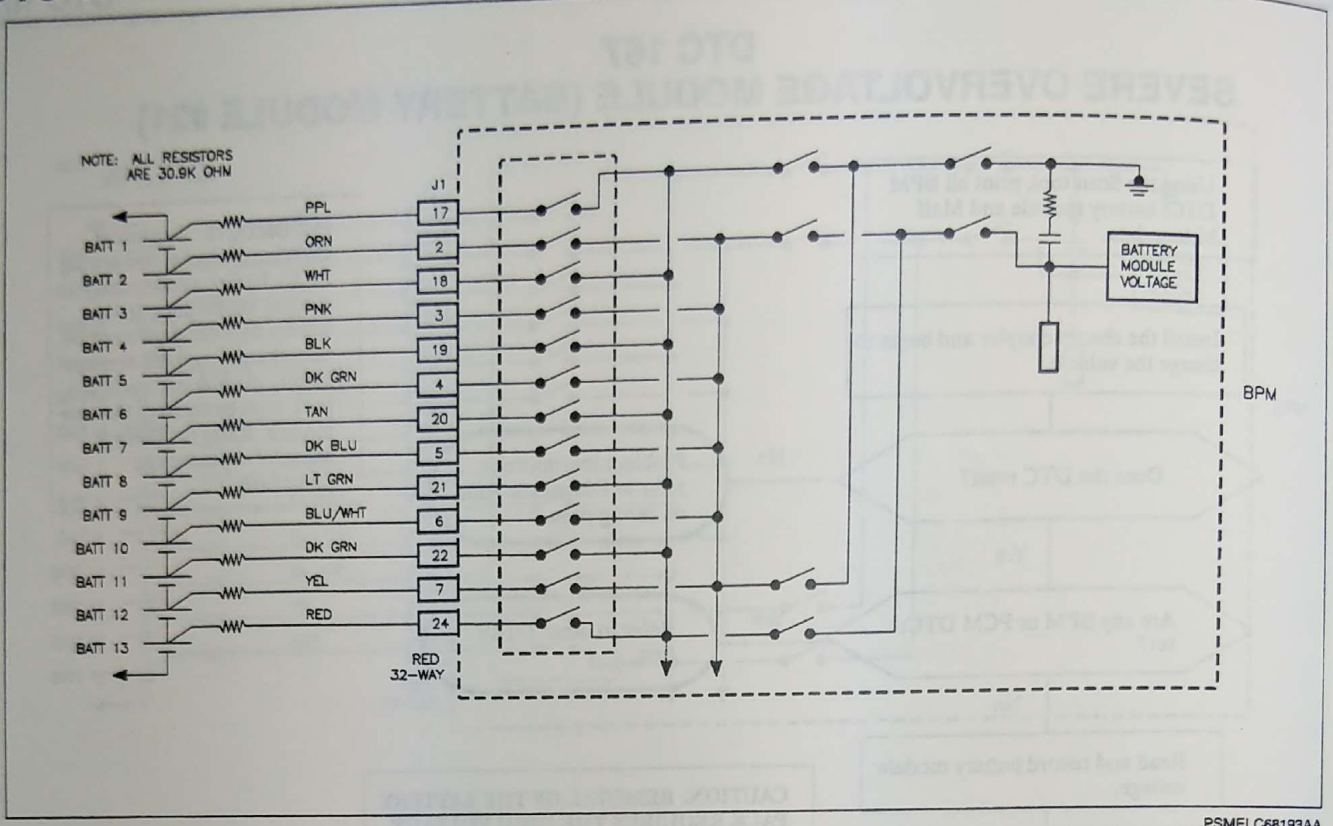
Was the connection ok?

No: Poor connection at battery module replace cable. After replacement measure module for correct voltage.

Yes: Wire between BPM and battery cable sense lead.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 169 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #22)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

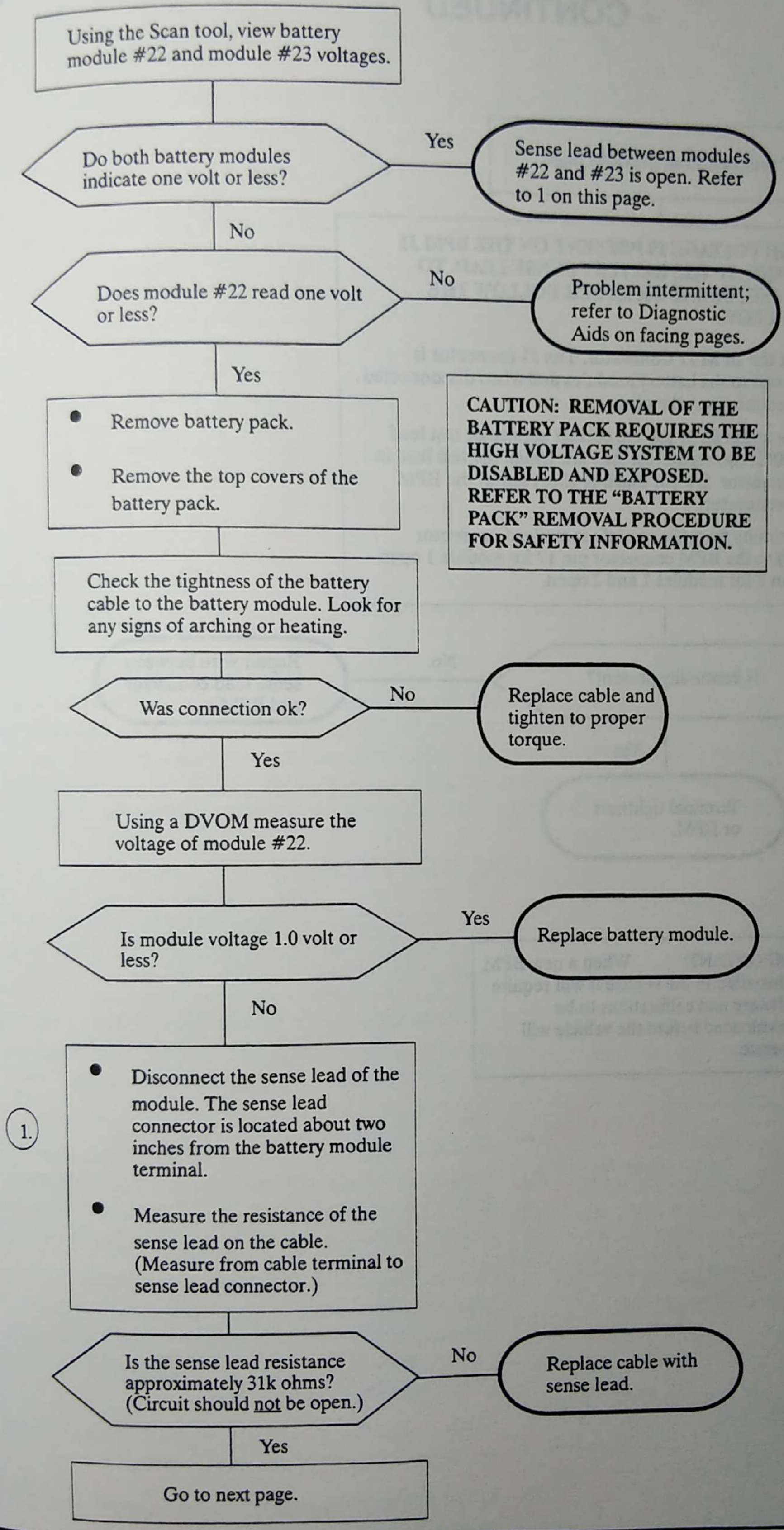
- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:
  1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
  2. Under "HIGH" discharge current (Heavy Load).
  3. When battery module state of charge (SOC) is "LOW."
- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 169

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #22)



Using the Scan tool, view battery module #22 and module #23 voltages.

Do both battery modules indicate one volt or less?

Yes: Sense lead between modules #22 and #23 is open. Refer to 1 on this page.

No: Does module #22 read one volt or less?

No: Problem intermittent; refer to Diagnostic Aids on facing pages.

Yes:

- Remove battery pack.
- Remove the top covers of the battery pack.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.

Was connection ok?

No: Replace cable and tighten to proper torque.

Yes: Using a DVOM measure the voltage of module #22.

Is module voltage 1.0 volt or less?

Yes: Replace battery module.

No:

1.

- Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
- Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)

Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)

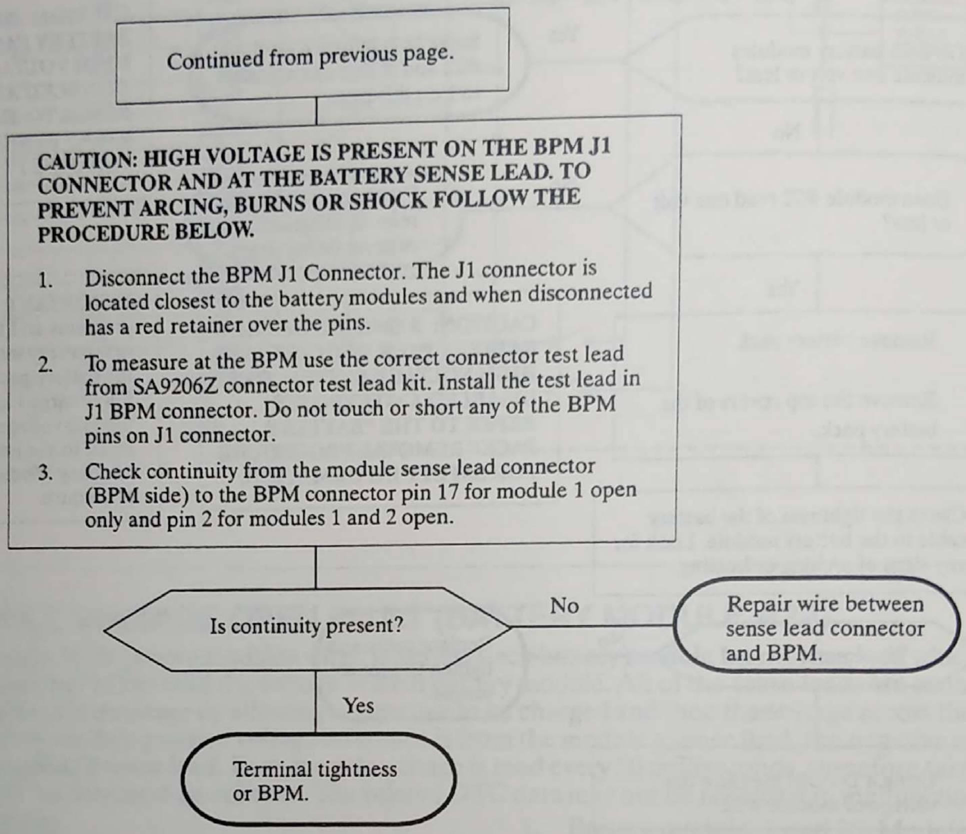
No: Replace cable with sense lead.

Yes: Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 169
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #22) – CONTINUED



Continued from previous page.

CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

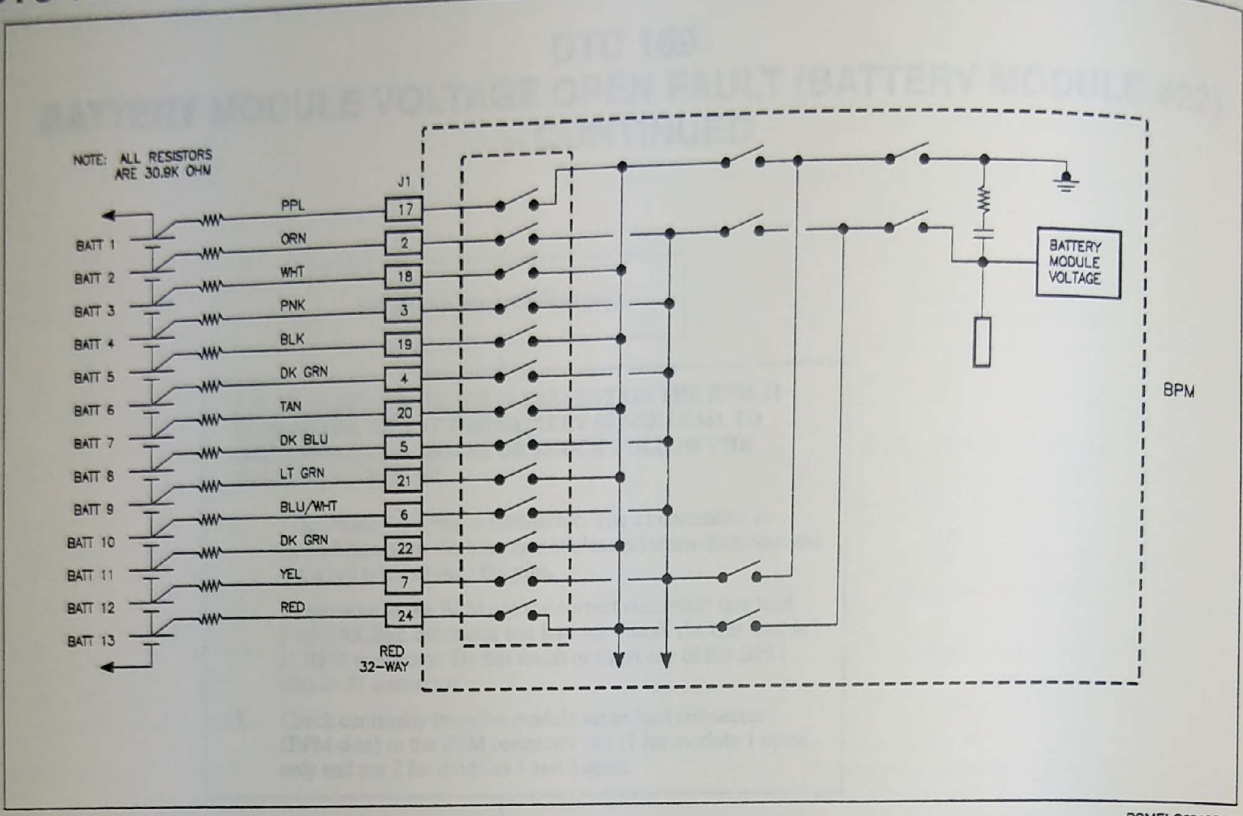
1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

Is continuity present?
No
Repair wire between sense lead connector and BPM.
Yes
Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 171 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #22)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zeroto 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #22: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

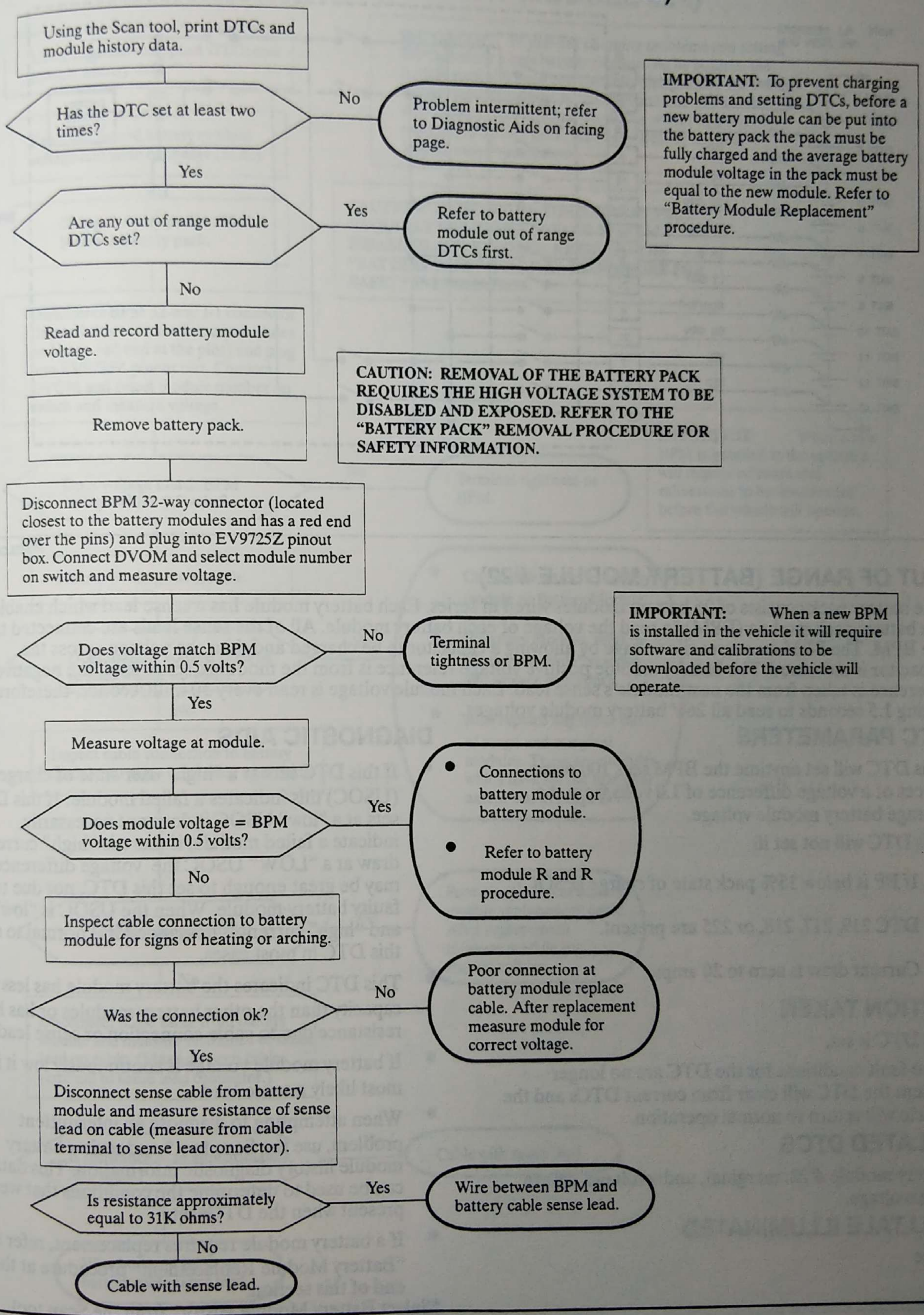
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

DTC 171
MARGINAL (BATTERY MODULE #22)


Using the Scan tool, print DTCs and module history data.
Has the DTC set at least two times?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any out of range module DTCs set?
Yes
Refer to battery module out of range DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
Connections to battery module or battery module.
Refer to battery module R and R procedure.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).
Is resistance approximately equal to 31K ohms?
Yes
Wire between BPM and battery cable sense lead.
No
Cable with sense lead.

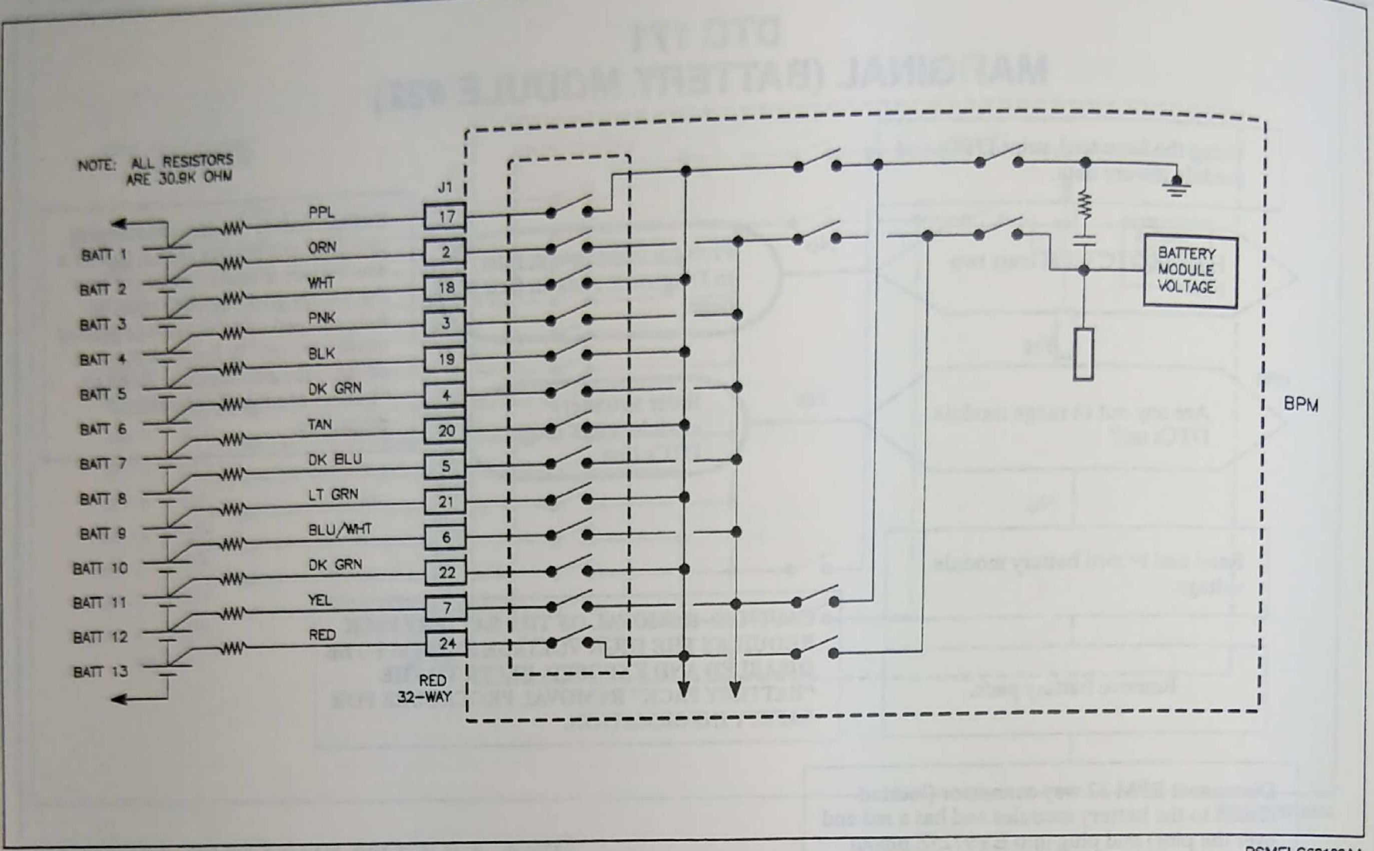
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

CS CamScanner

DTC 172 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #22)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #22: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

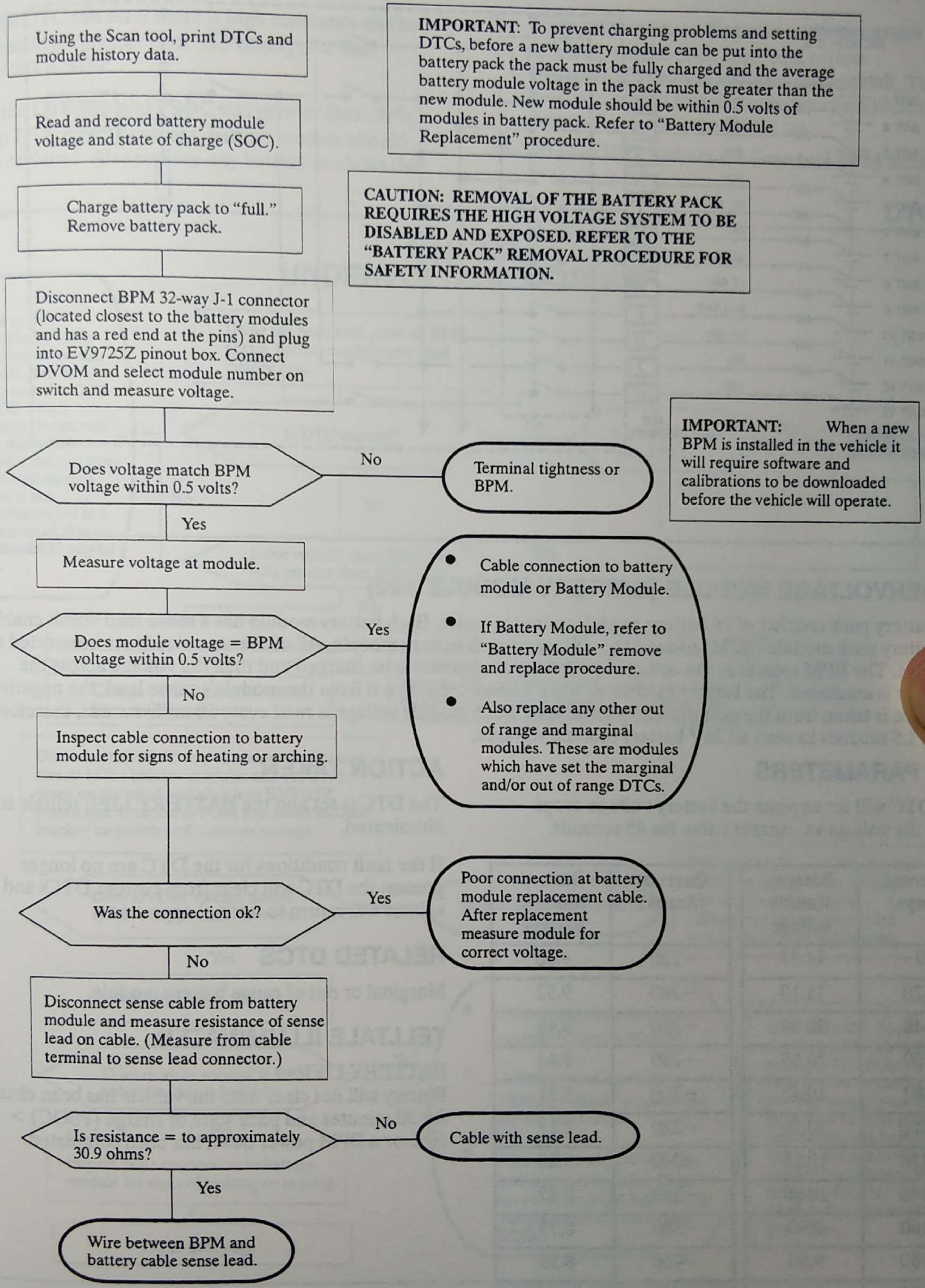
None

DIAGNOSTIC AIDS

- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

*Select Battery Module History from the Scan tool BPM menu.

DTC 172
OUT OF RANGE (BATTERY MODULE #22)



Using the Scan tool, print DTCs and module history data.

Read and record battery module voltage and state of charge (SOC).

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

No: Terminal tightness or BPM.

Yes: Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

Yes:

- Cable connection to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

No: Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Yes: Poor connection at battery module replacement cable. After replacement measure module for correct voltage.

No: Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)

Is resistance = to approximately 30.9 ohms?

No: Cable with sense lead.

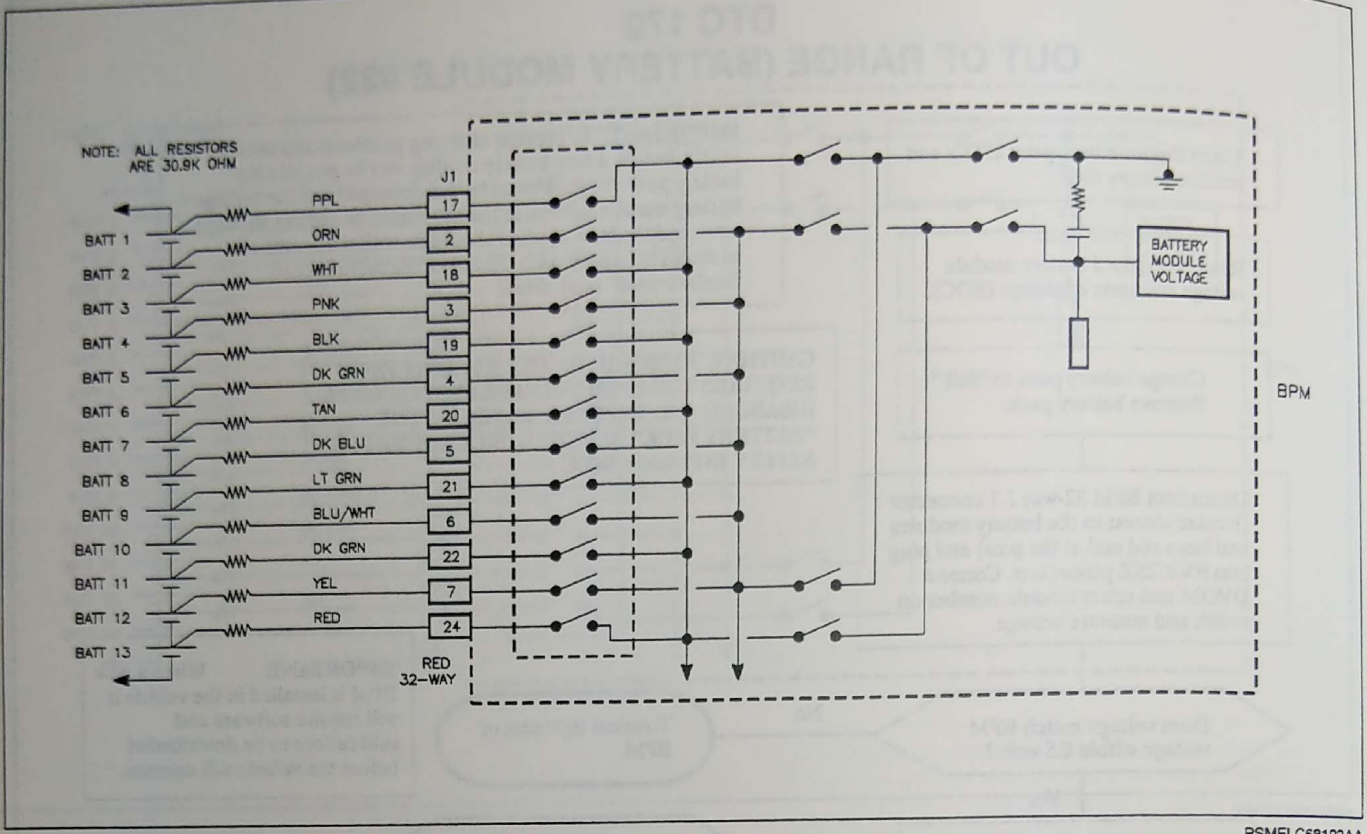
Yes: Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 173 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED
32–WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #22)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage	Current (Amps)	Battery Module Voltage
0	11.75	−220	9.60
−20	11.10	−240	9.52
−40	10.90	−260	9.48
−60	10.65	−280	9.44
−80	10.45	−300	9.31
−100	10.30	−320	9.17
−120	10.15	−340	9.03
−140	10.00	−360	8.87
−160	9.90	−380	8.73
−180	9.80	−400	8.59
−200	9.70		

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

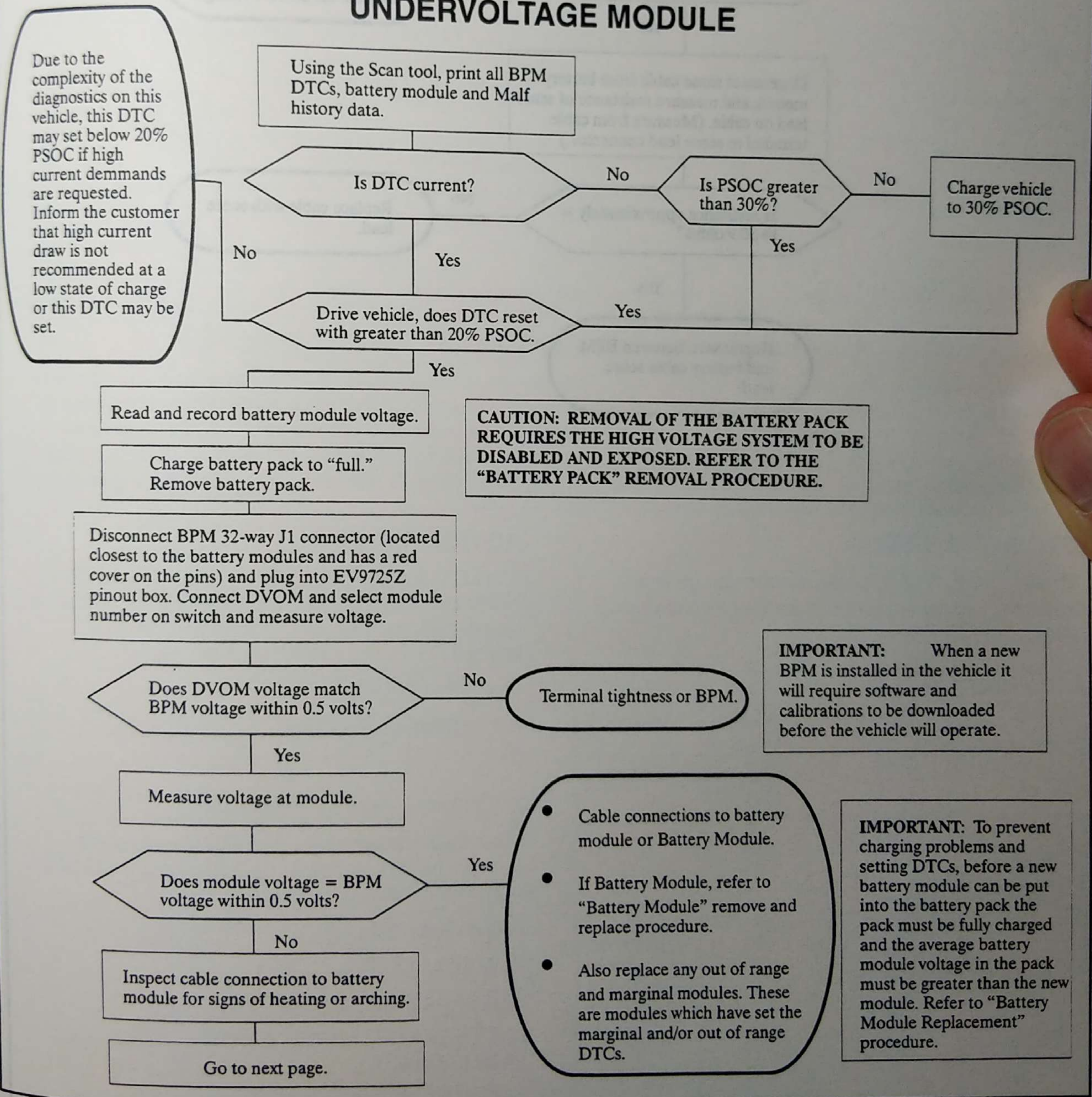
BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below zero percent user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 173
UNDERVOLTAGE MODULE

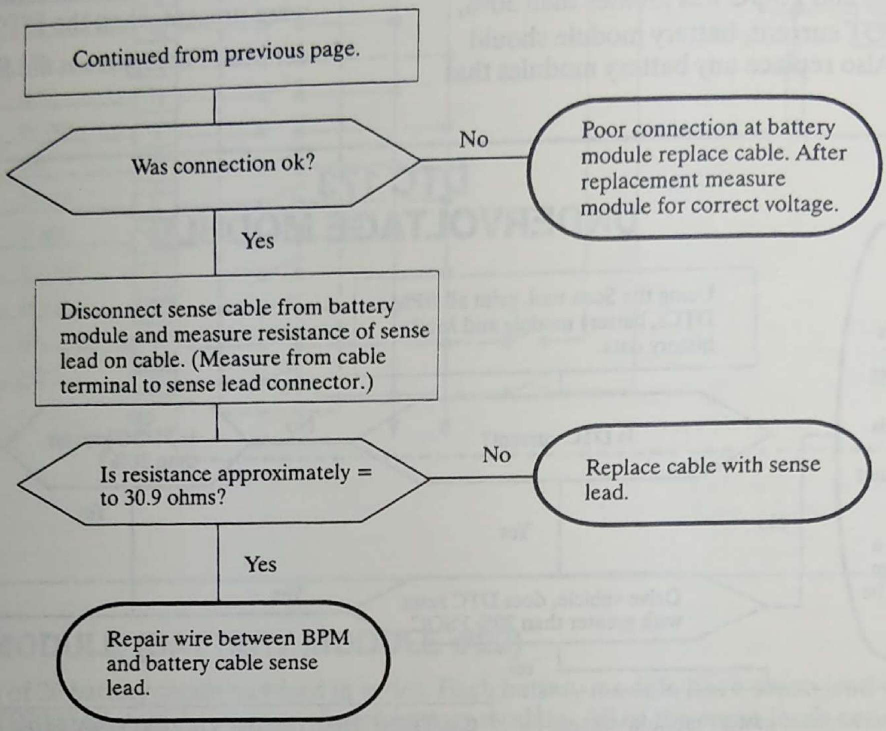

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

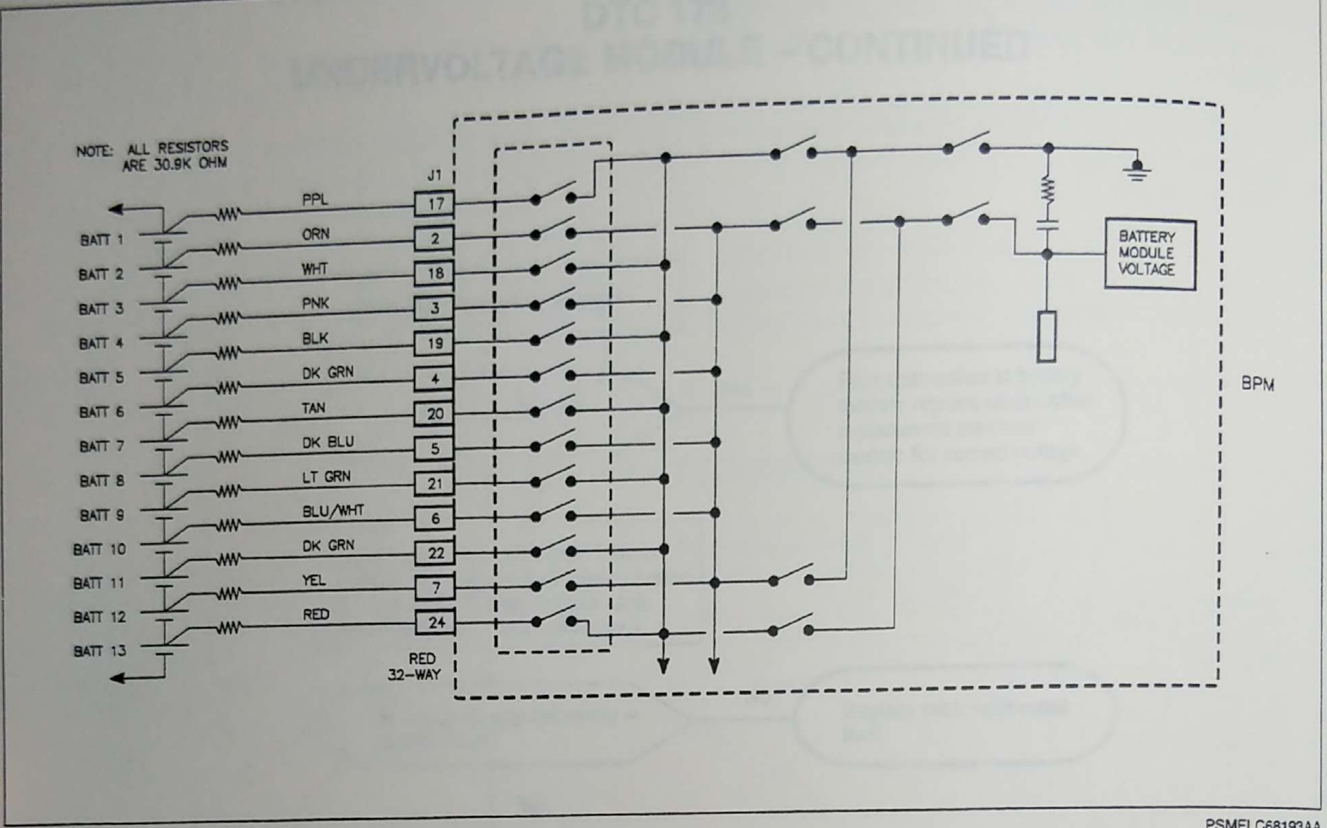
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 173
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 174 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
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19
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20
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21
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22
7
24
RED 32–WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #22)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

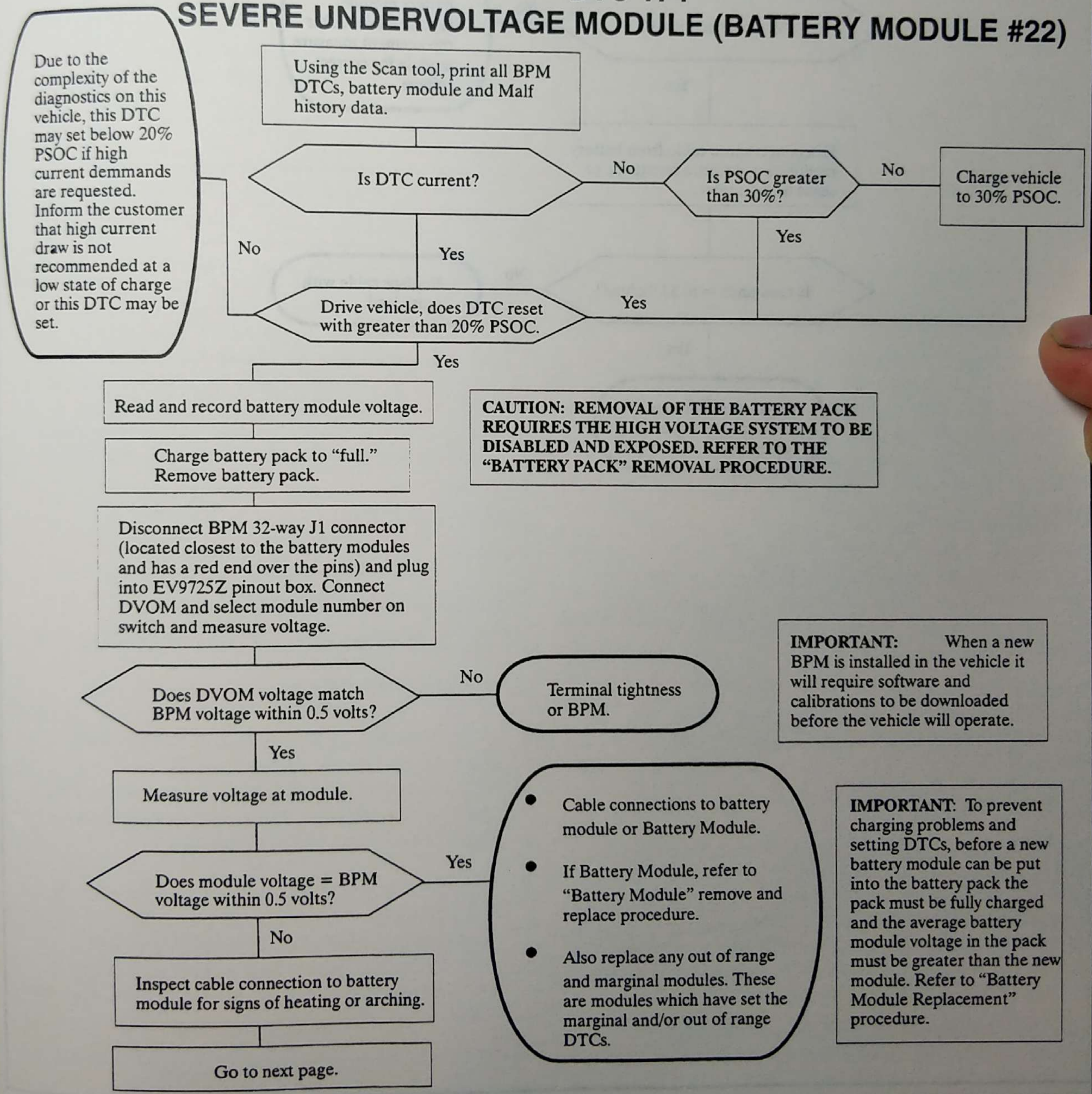
Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches zero percent user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 174
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #22)

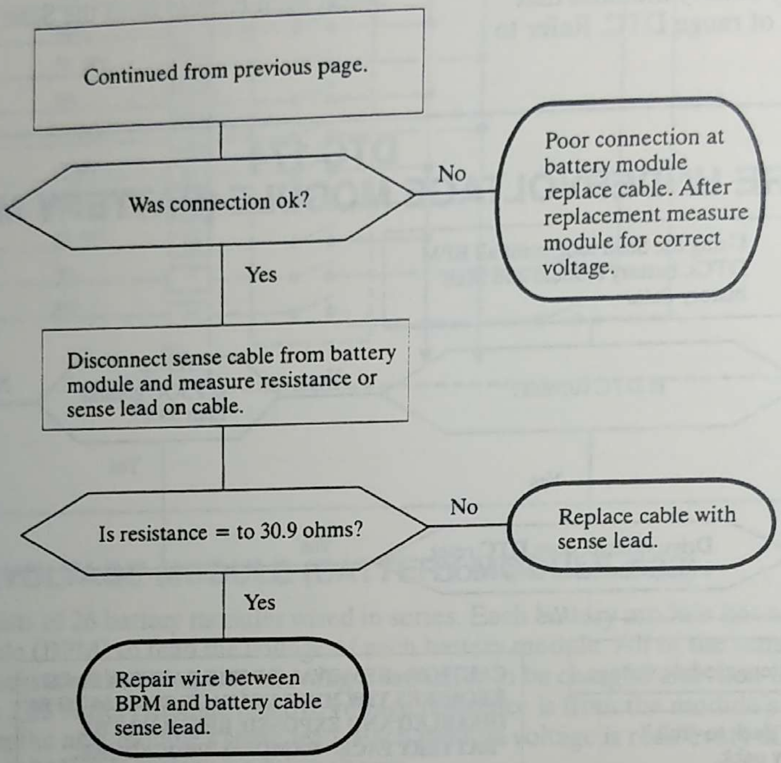

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
Cable connections to battery module or Battery Module.
If Battery Module, refer to "Battery Module" remove and replace procedure.
Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

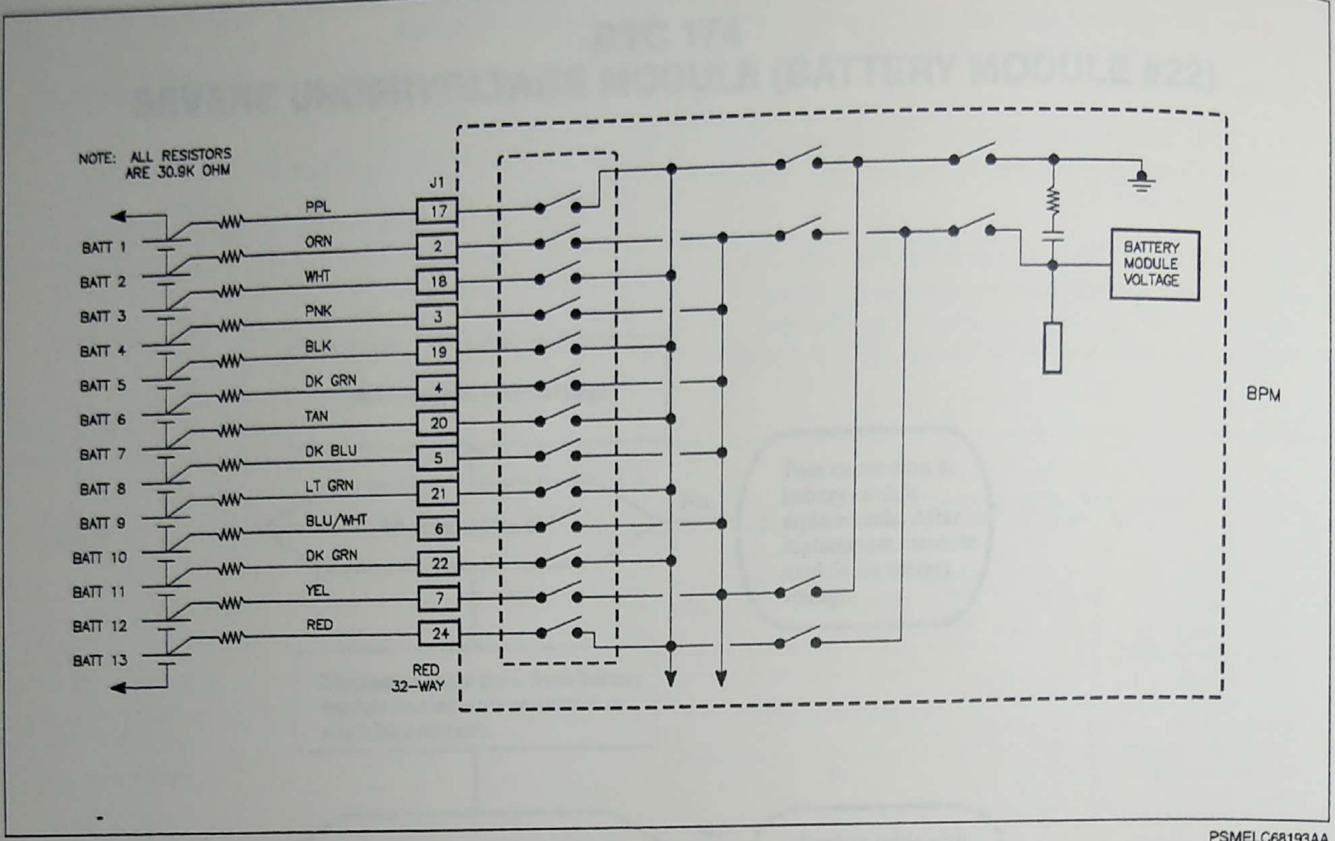
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 174
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #22)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 175 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #22)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

SERVICE NOW and REDUCED PERFORMANCE

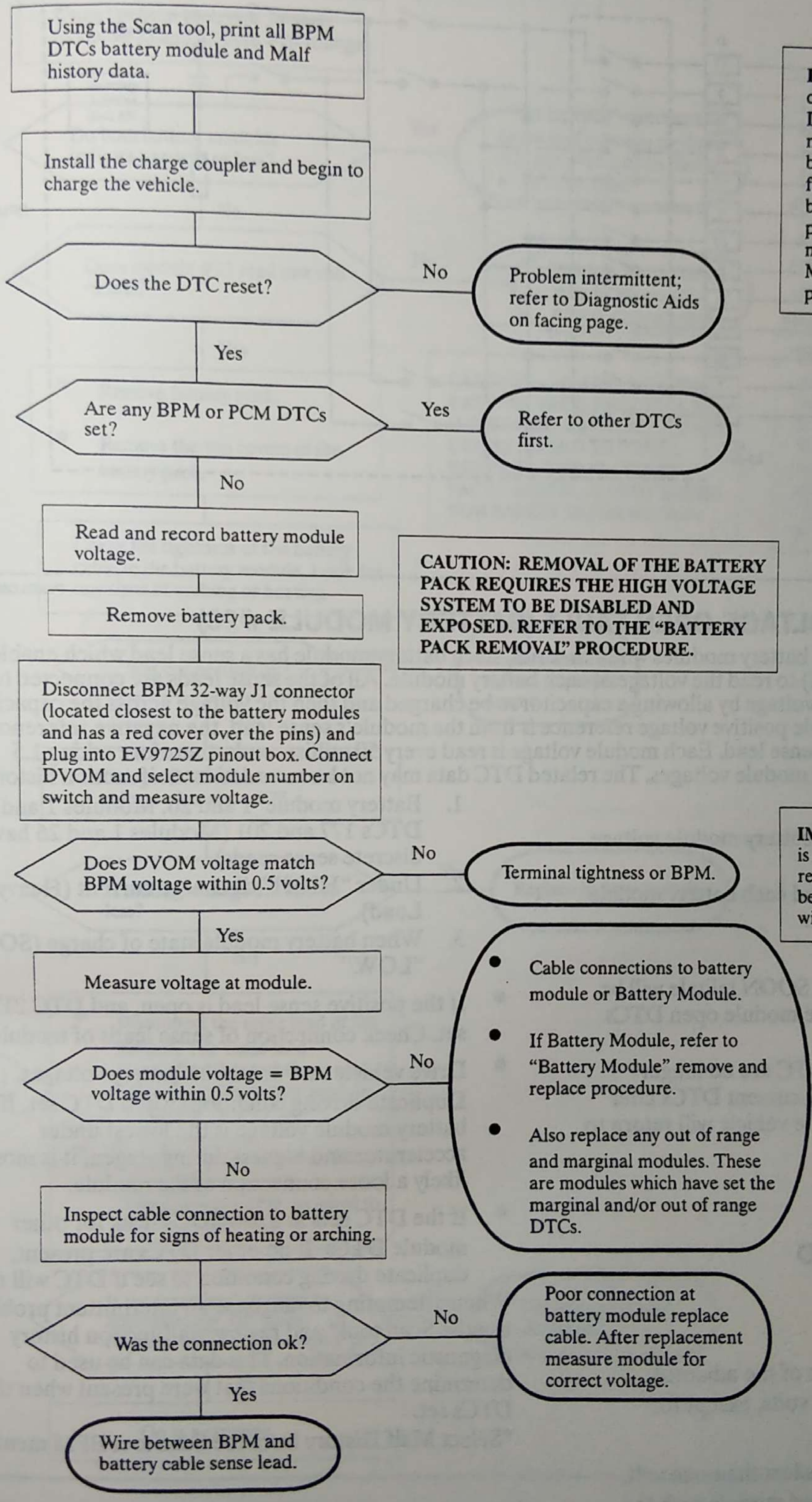
DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

DTC 175
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #22)

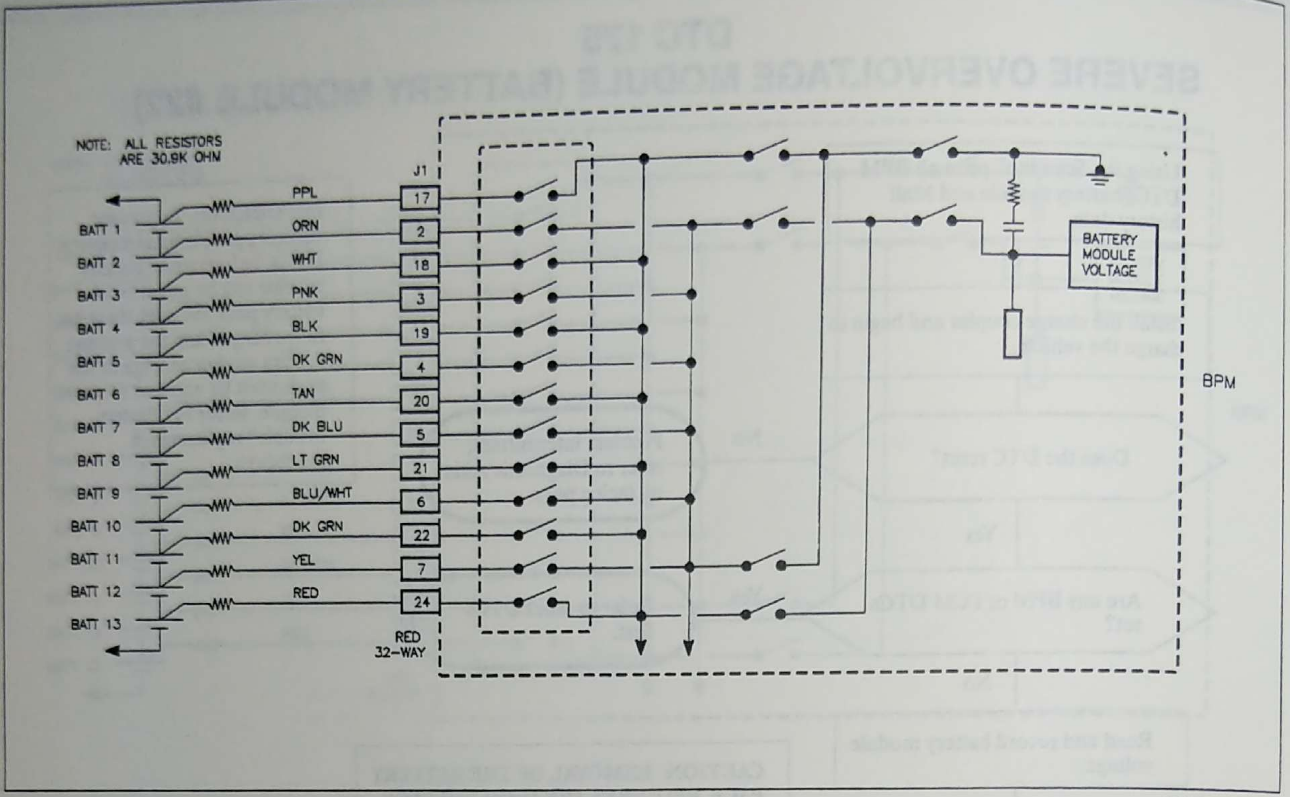
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.


Using the Scan tool, print all BPM DTCs battery module and Malf history data.
Install the charge coupler and begin to charge the vehicle.
Does the DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any BPM or PCM DTCs set?
Yes
Refer to other DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
No
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Wire between BPM and battery cable sense lead.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 177 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #23)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

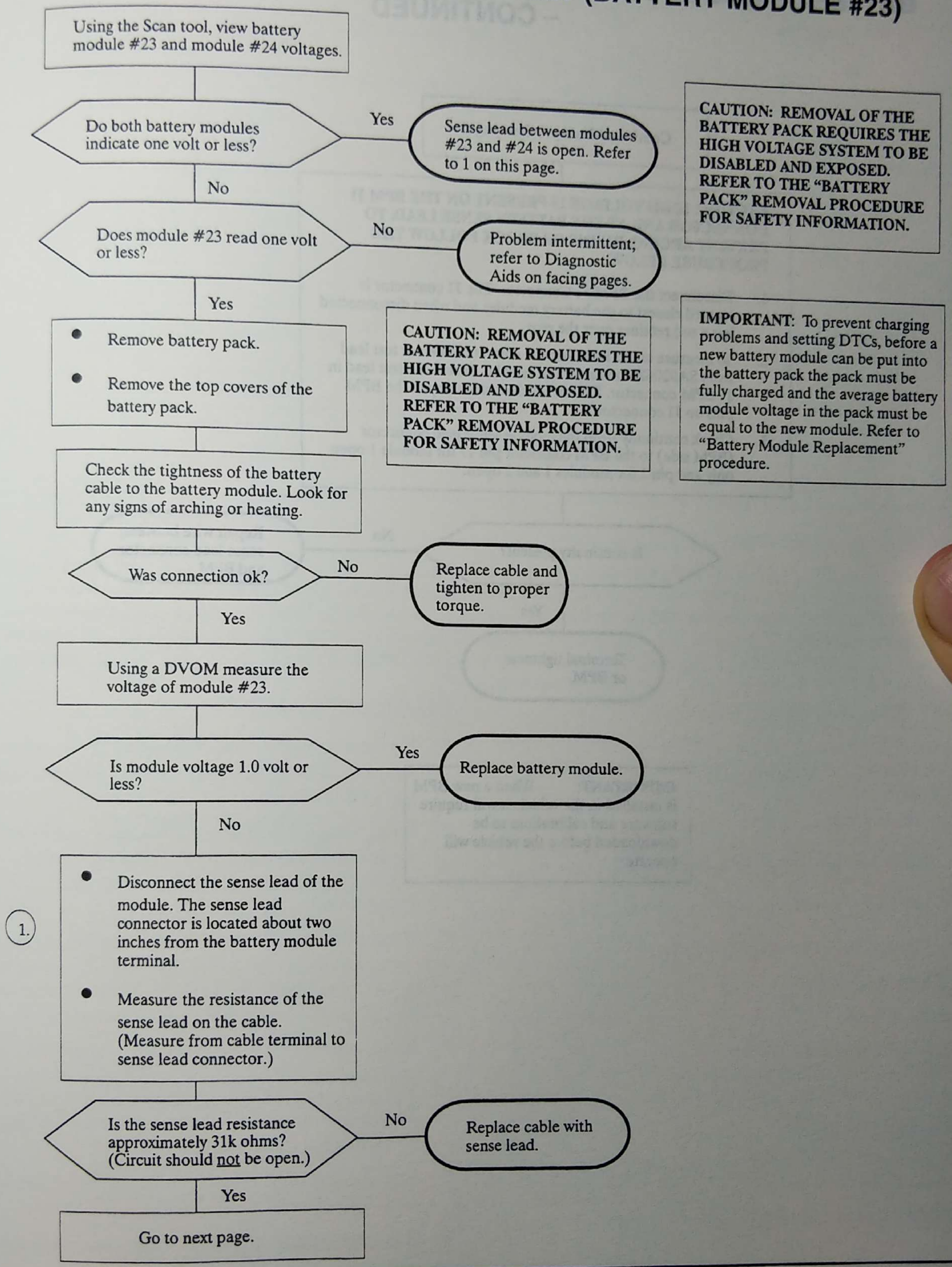
- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:
  1. Battery module 1 and 26. Modules 1 and 26, DTCs 177 and 201 (Modules 1 and 26 have discrete sense reads).
  2. Under "HIGH" discharge current (Heavy Load).
  3. When battery module state of charge (SOC) is "LOW."
- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 177

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #23)

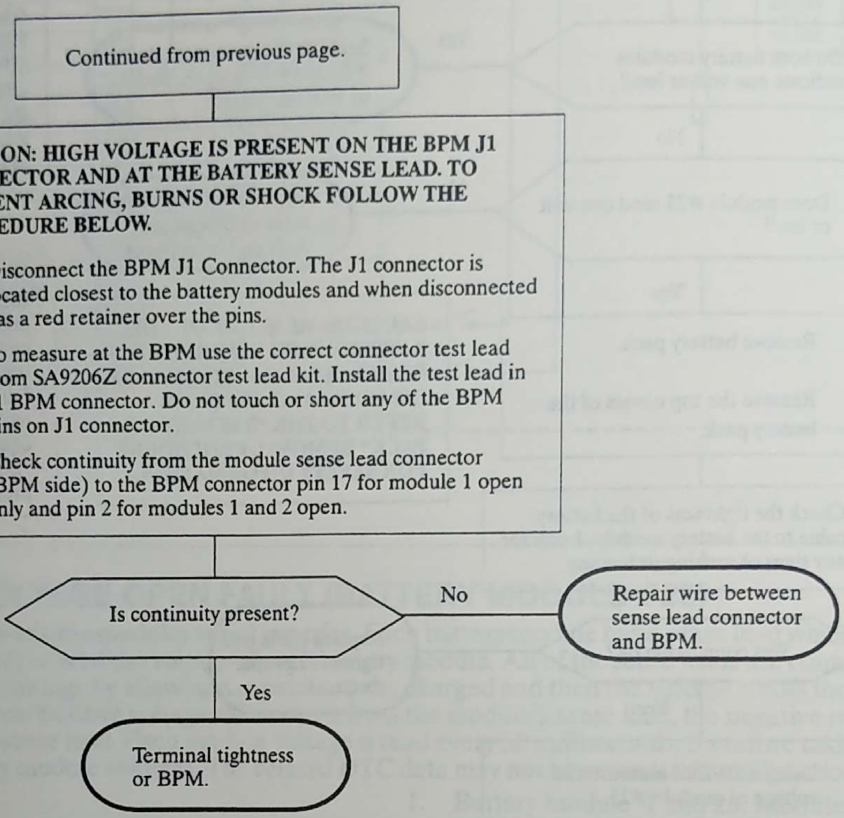

Using the Scan tool, view battery module #23 and module #24 voltages.
Do both battery modules indicate one volt or less?
Yes
Sense lead between modules #23 and #24 is open. Refer to 1 on this page.
No
Does module #23 read one volt or less?
No
Problem intermittent; refer to Diagnostic Aids on facing pages.
Yes
• Remove battery pack.
• Remove the top covers of the battery pack.
Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.
Was connection ok?
No
Replace cable and tighten to proper torque.
Yes
Using a DVOM measure the voltage of module #23.
Is module voltage 1.0 volt or less?
Yes
Replace battery module.
No
1.
• Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
• Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)
Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)
No
Replace cable with sense lead.
Yes
Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 177
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #23) – CONTINUED



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CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

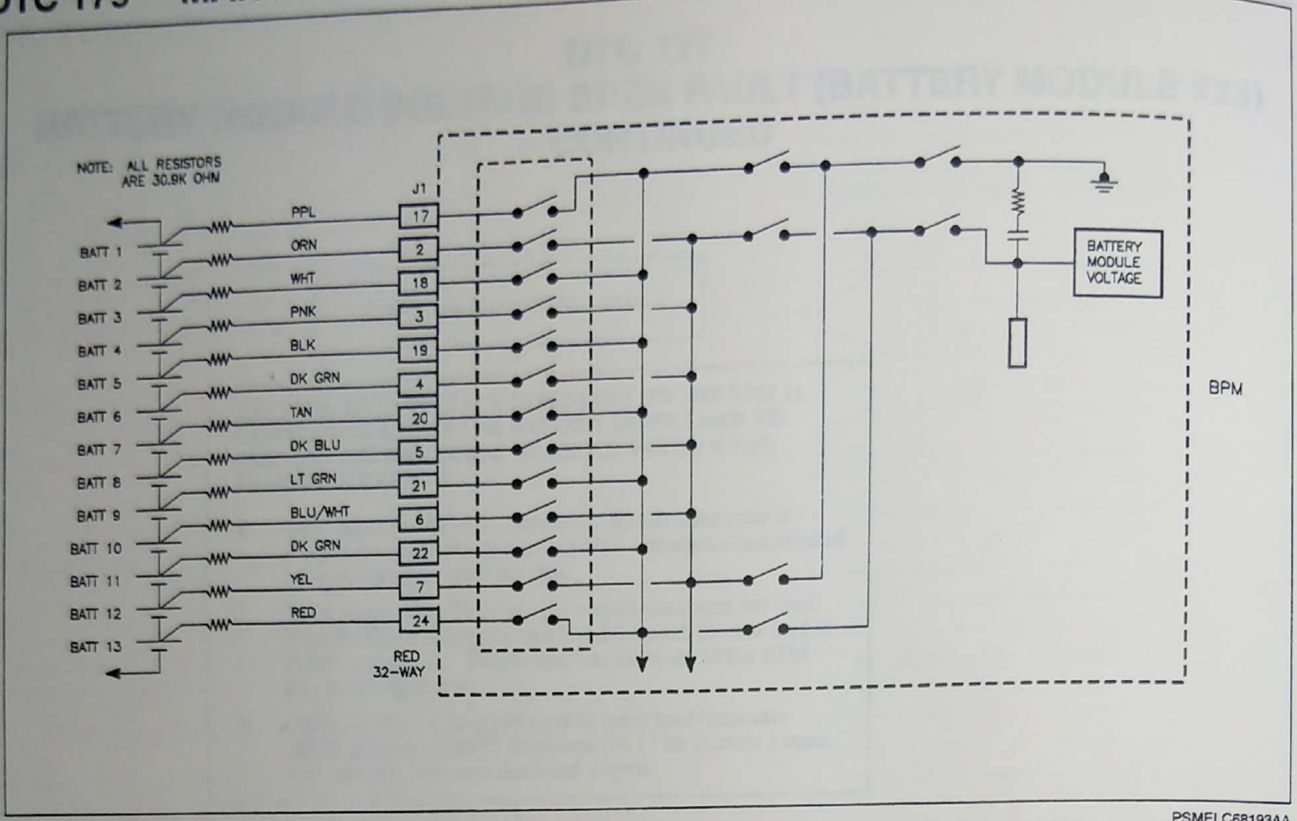
1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

Is continuity present?
No
Repair wire between sense lead connector and BPM.
Yes
Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 179 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #23)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #23: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

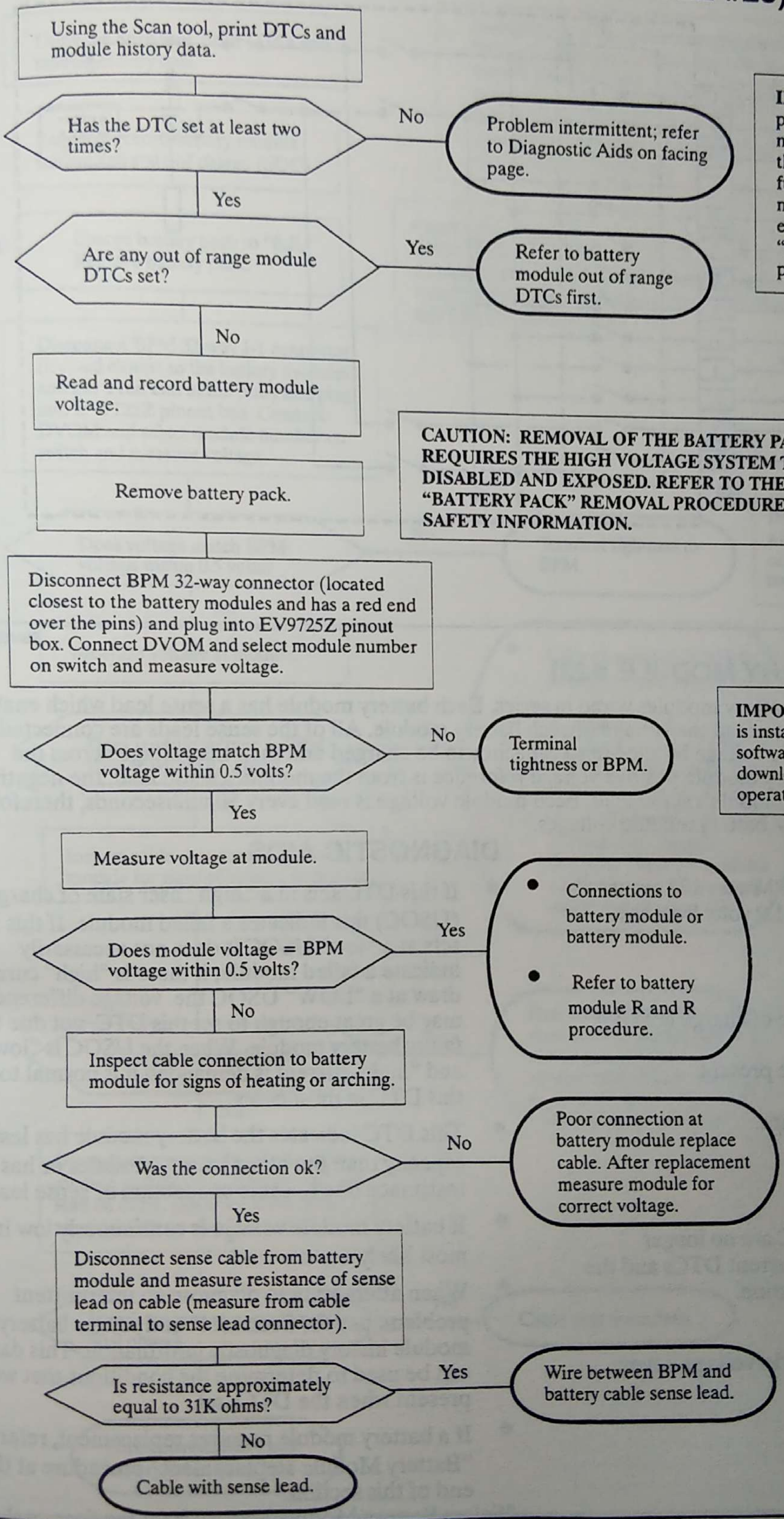
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section..
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

DTC 179
MARGINAL (BATTERY MODULE #23)



Using the Scan tool, print DTCs and module history data.

Has the DTC set at least two times?

Problem intermittent; refer to Diagnostic Aids on facing page.

Are any out of range module DTCs set?

Refer to battery module out of range DTCs first.

Read and record battery module voltage.

Remove battery pack.

Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Connections to battery module or battery module.
- Refer to battery module R and R procedure.

Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Poor connection at battery module replace cable. After replacement measure module for correct voltage.

Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).

Is resistance approximately equal to 31K ohms?

Wire between BPM and battery cable sense lead.

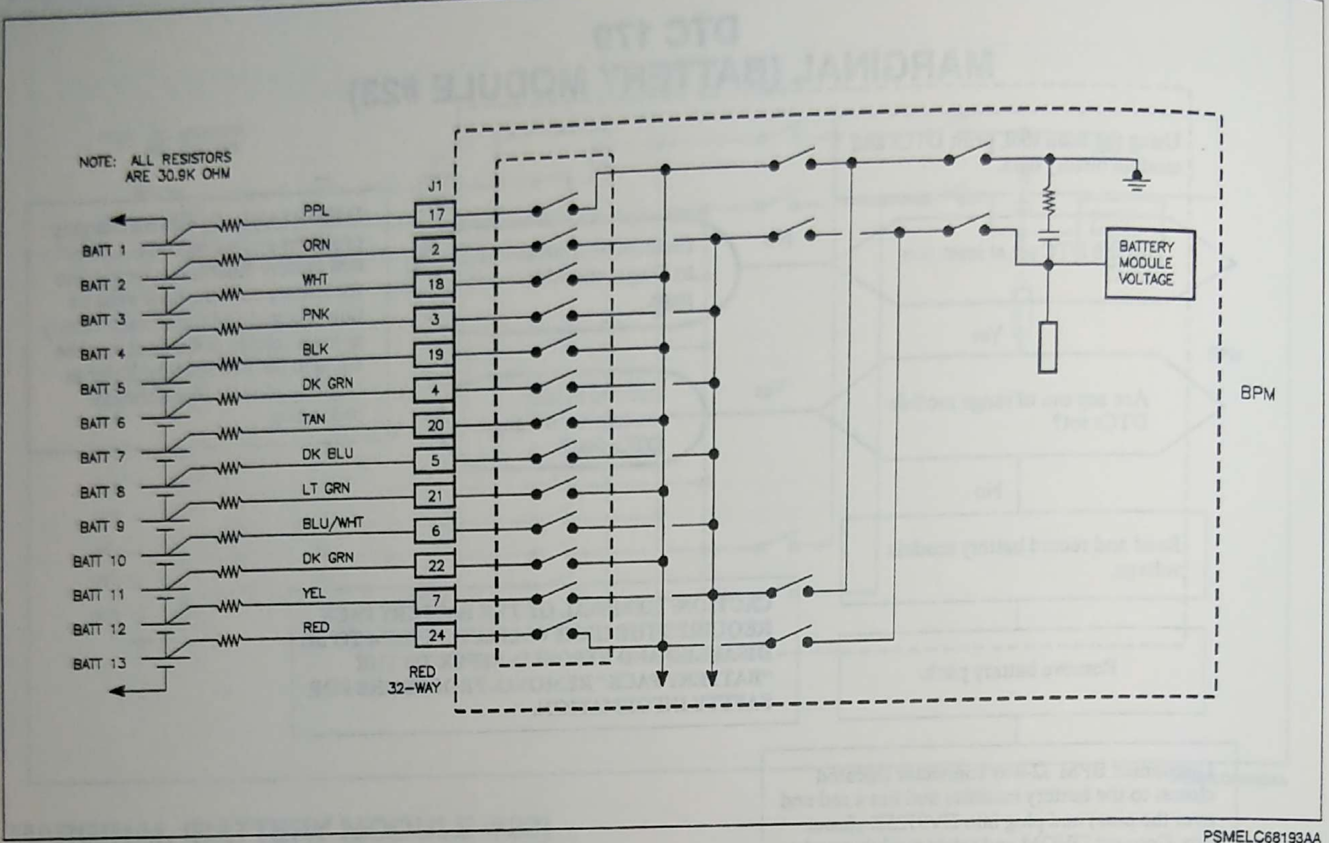
Cable with sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 180 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #23)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #23: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

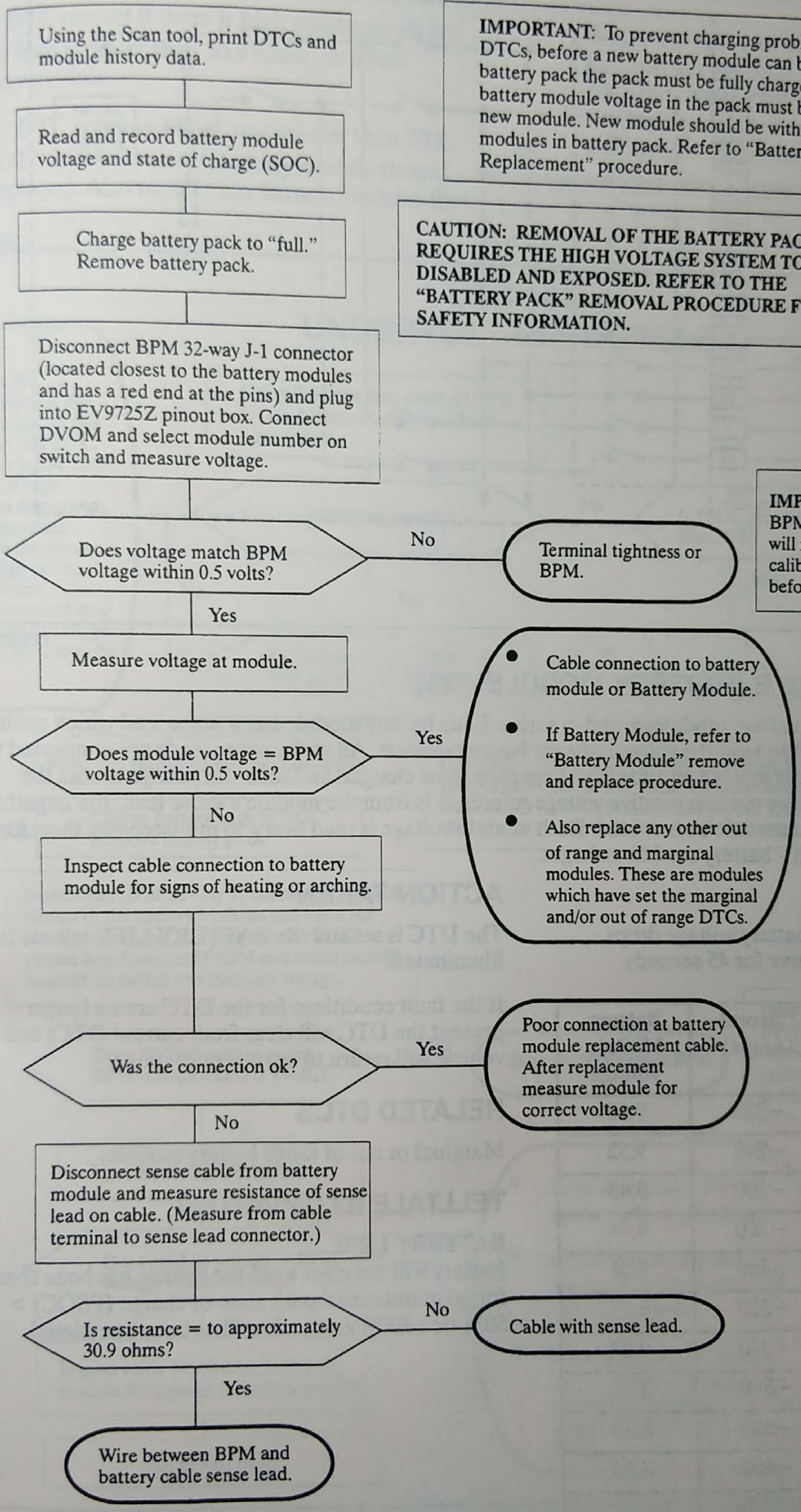
- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

*Select Battery Module History from the Scan tool BPM menu.

DTC 180
OUT OF RANGE (BATTERY MODULE #23)

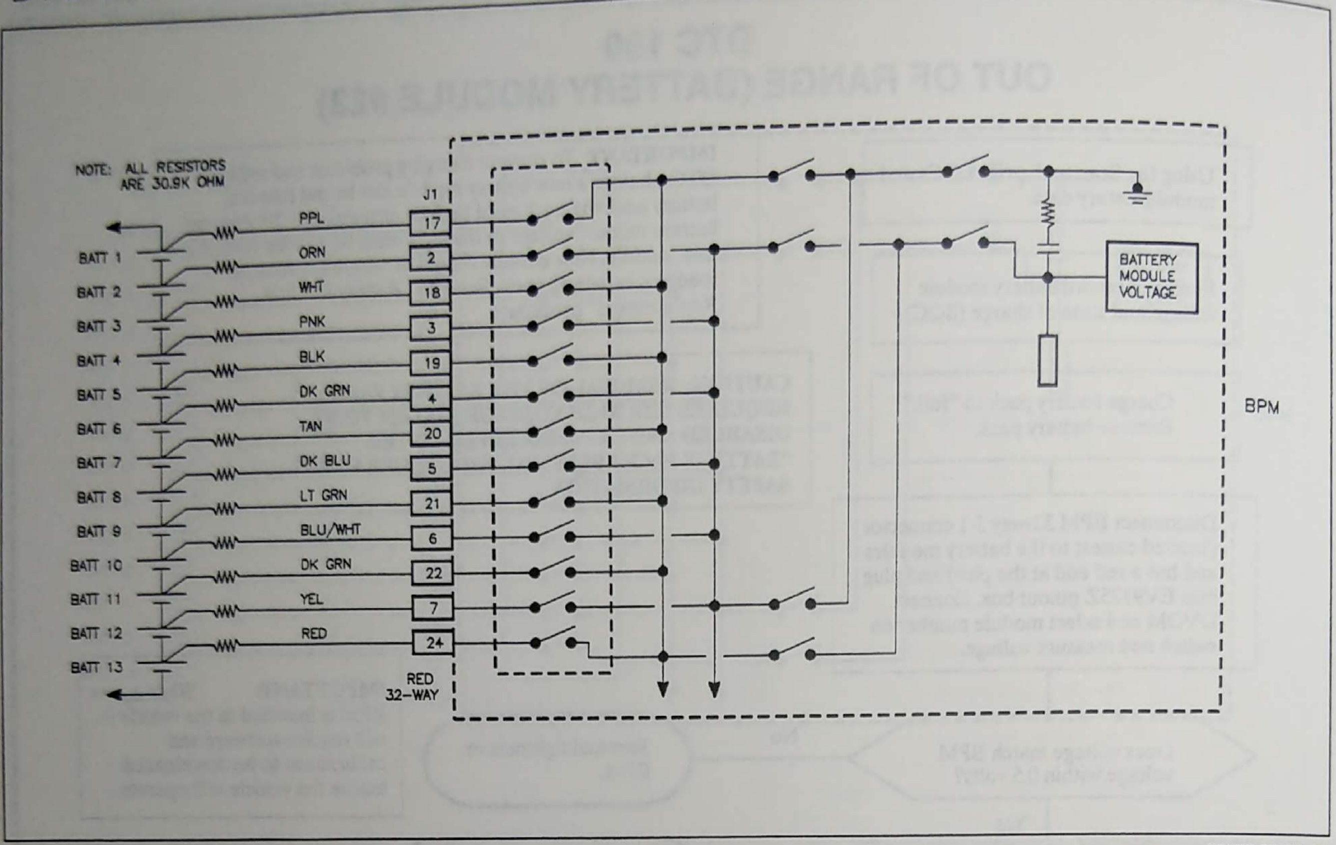
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.


Using the Scan tool, print DTCs and module history data.
Read and record battery module voltage and state of charge (SOC).
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Cable connection to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
Yes
Poor connection at battery module replacement cable. After replacement measure module for correct voltage.
No
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance = to approximately 30.9 ohms?
No
Cable with sense lead.
Yes
Wire between BPM and battery cable sense lead.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 181 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
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21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #23)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage	Current (Amps)	Battery Module Voltage
0	11.75	–220	9.60
–20	11.10	–240	9.52
–40	10.90	–260	9.48
–60	10.65	–280	9.44
–80	10.45	–300	9.31
–100	10.30	–320	9.17
–120	10.15	–340	9.03
–140	10.00	–360	8.87
–160	9.90	–380	8.73
–180	9.80	–400	8.59
–200	9.70		

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

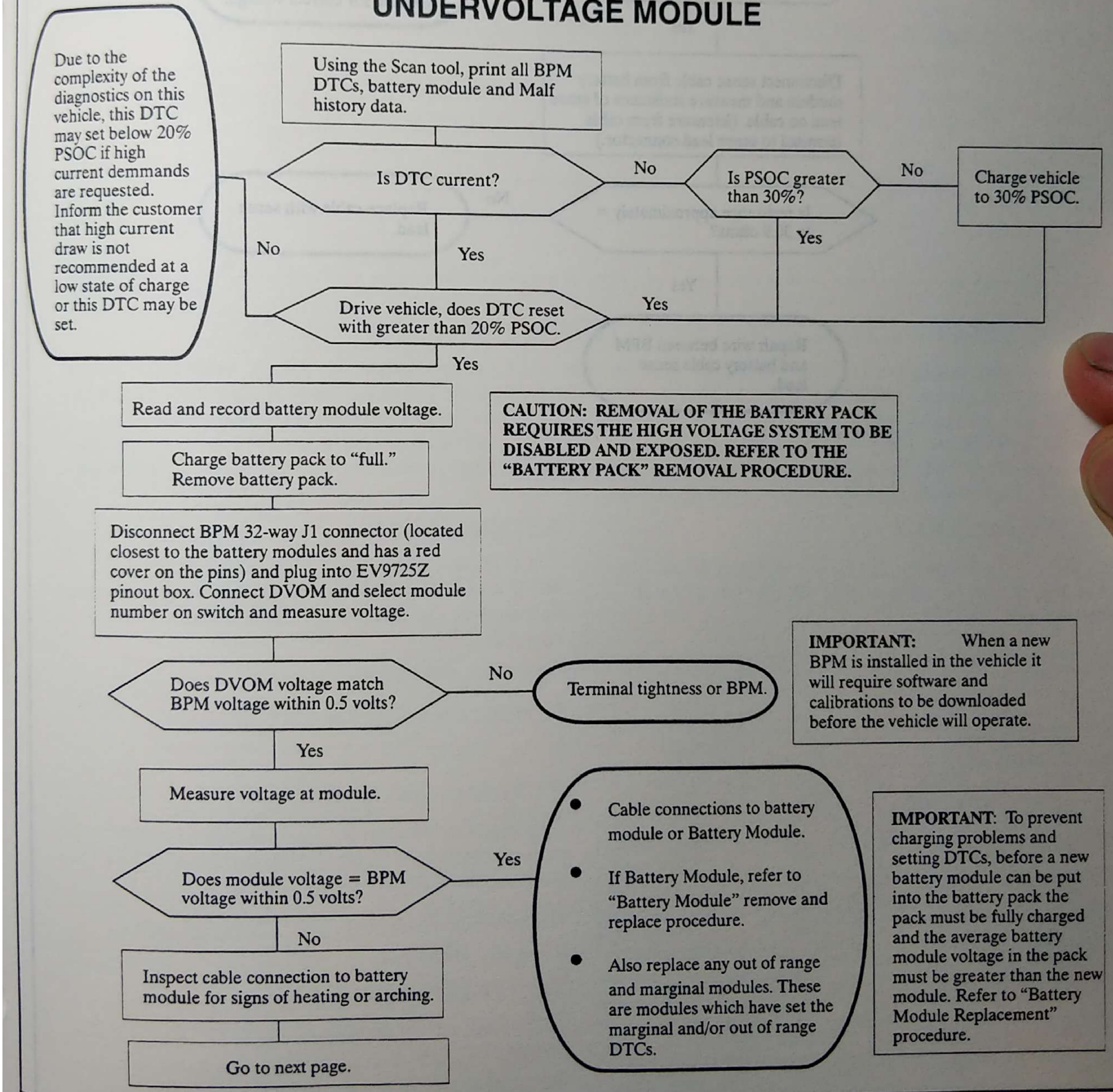
DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below zero percent user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 181

DTC 181
UNDERVOLTAGE MODULE

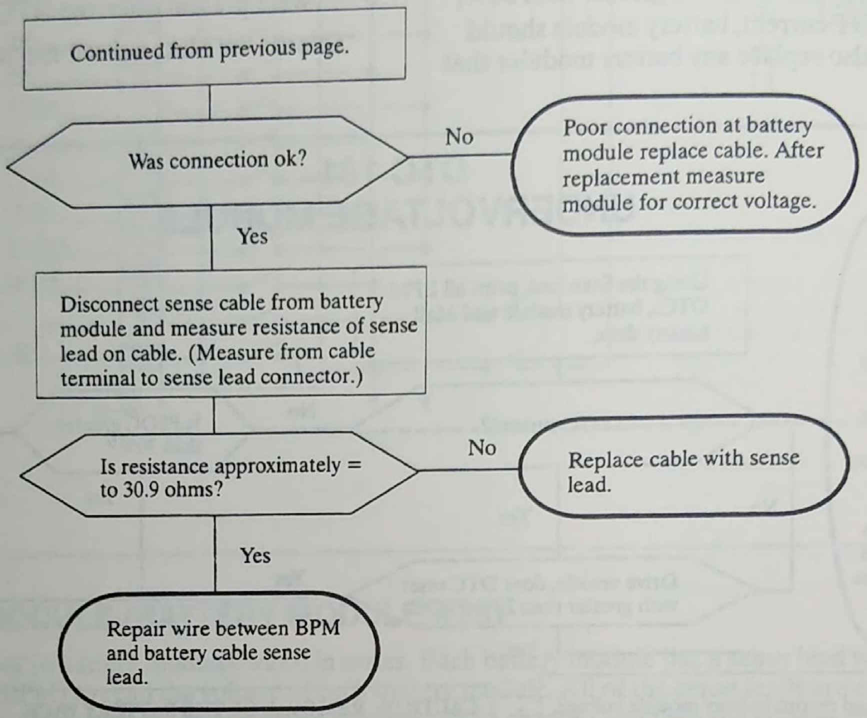

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malf history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
Cable connections to battery module or Battery Module.
If Battery Module, refer to "Battery Module" remove and replace procedure.
Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

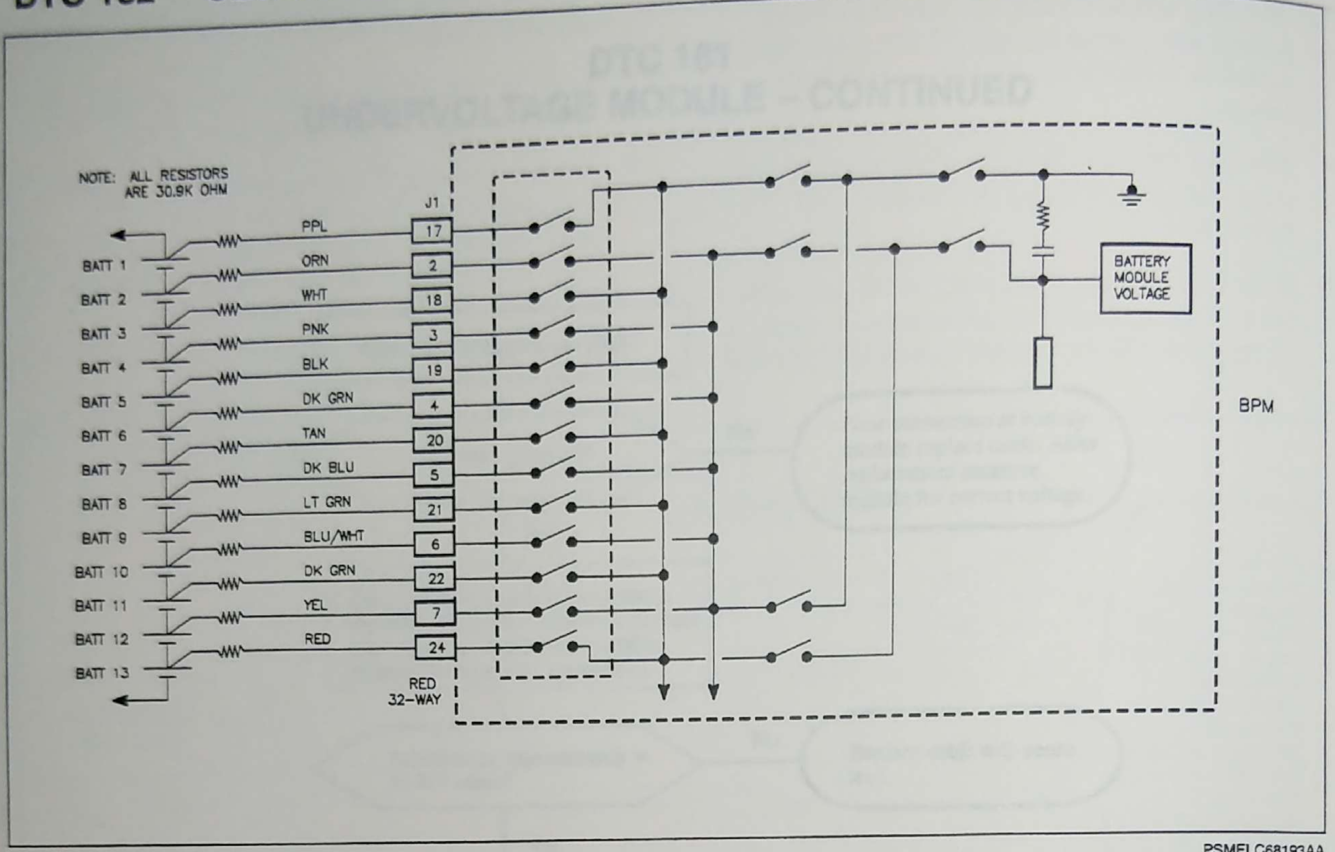
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 181
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 182 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
PPL
17
ORN
2
WHT
18
PNK
3
BLK
19
DK GRN
4
TAN
20
DK BLU
5
LT GRN
21
BLU/WHT
6
DK GRN
22
YEL
7
RED
24
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #23)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

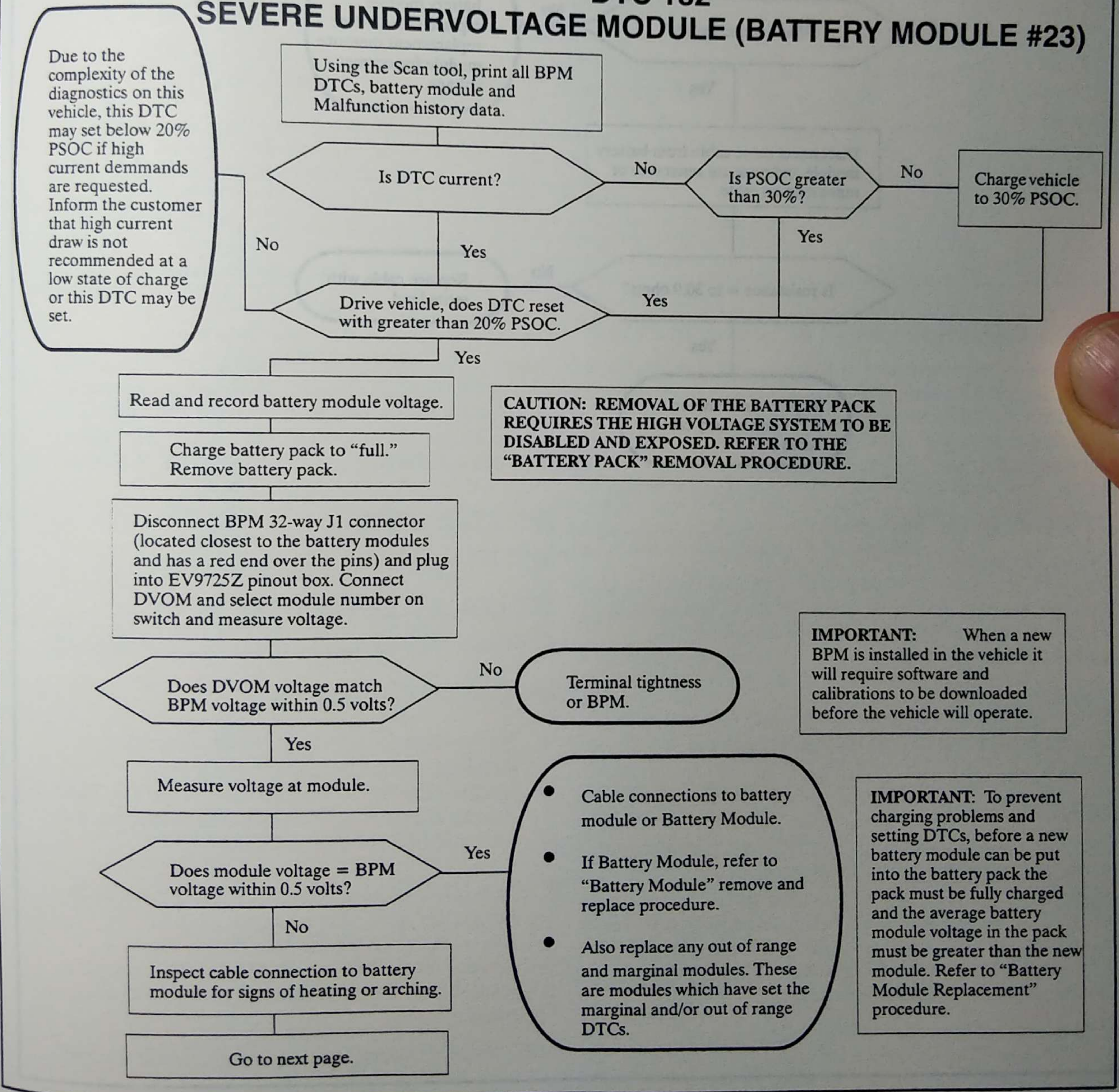
Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches zero percent user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 182
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #23)


Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and Malfunction history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
No
Yes
Yes
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
Cable connections to battery module or Battery Module.
If Battery Module, refer to "Battery Module" remove and replace procedure.
Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

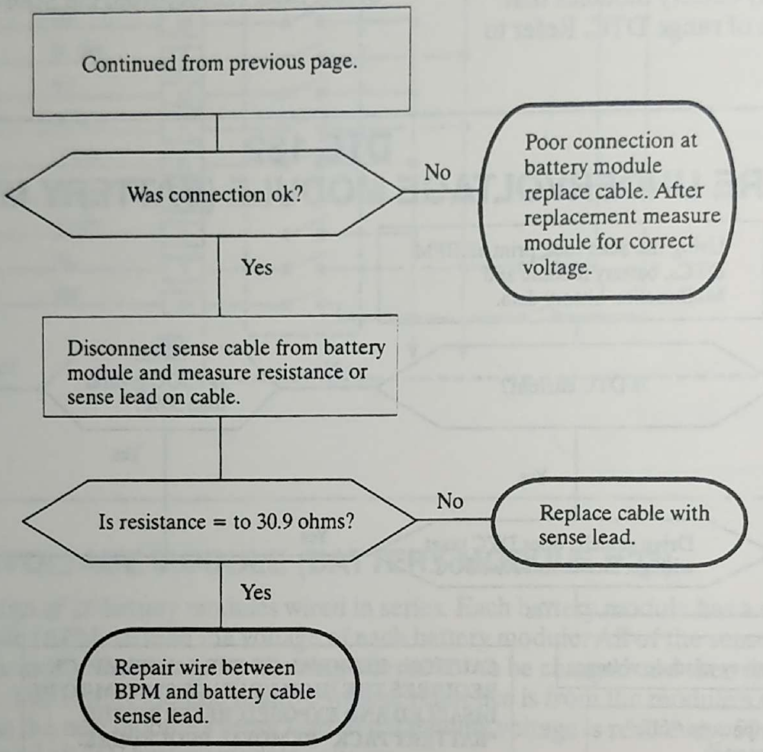
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

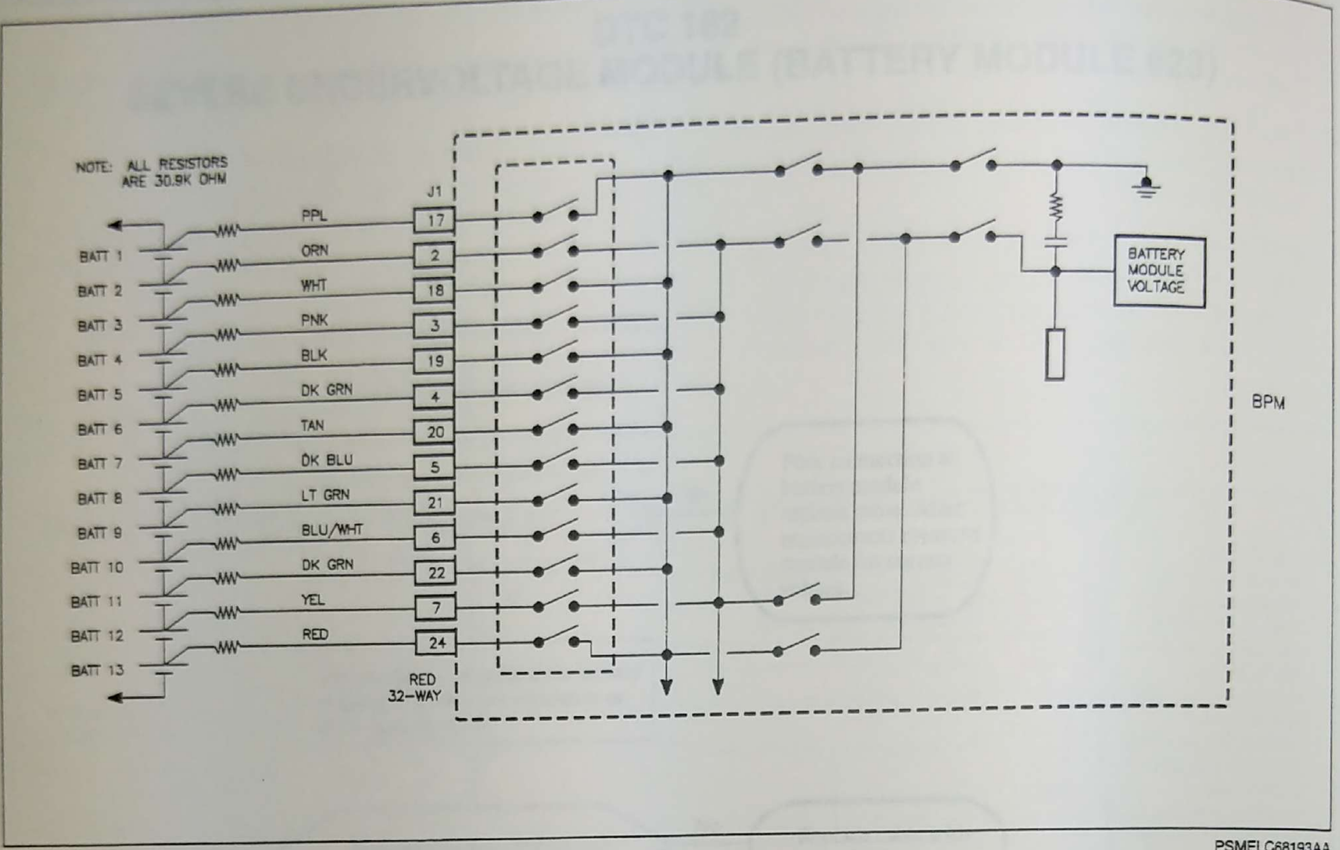
DTC 182

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #23)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 183 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #23)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

SERVICE NOW and REDUCED PERFORMANCE

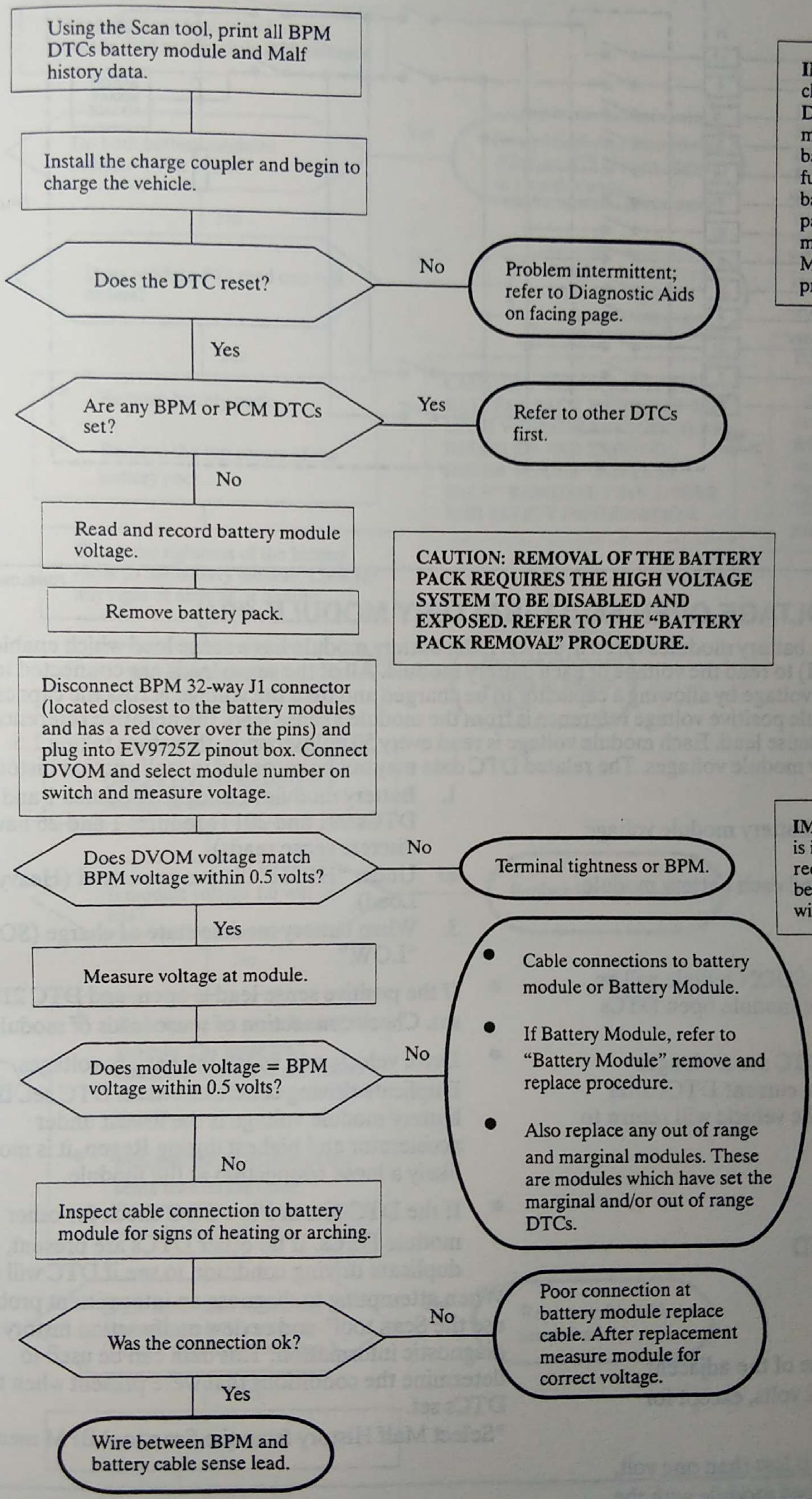
DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

DTC 183
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #23)

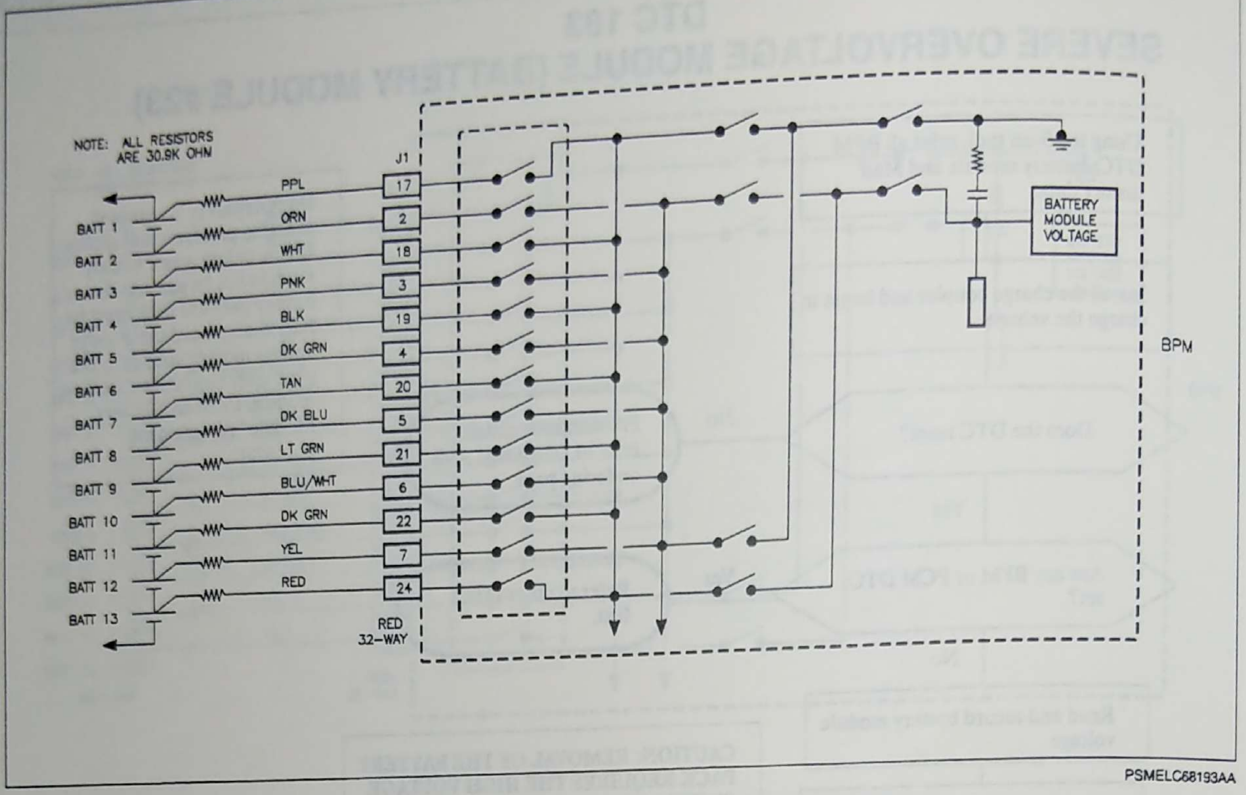
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.


Using the Scan tool, print all BPM DTCs battery module and Malf history data.
Install the charge coupler and begin to charge the vehicle.
Does the DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any BPM or PCM DTCs set?
Yes
Refer to other DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
No
Cable connections to battery module or Battery Module.
If Battery Module, refer to "Battery Module" remove and replace procedure.
Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Wire between BPM and battery cable sense lead.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 185 – BATTERY MODULE VOLTAGE OPEN FAULT



BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #24)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

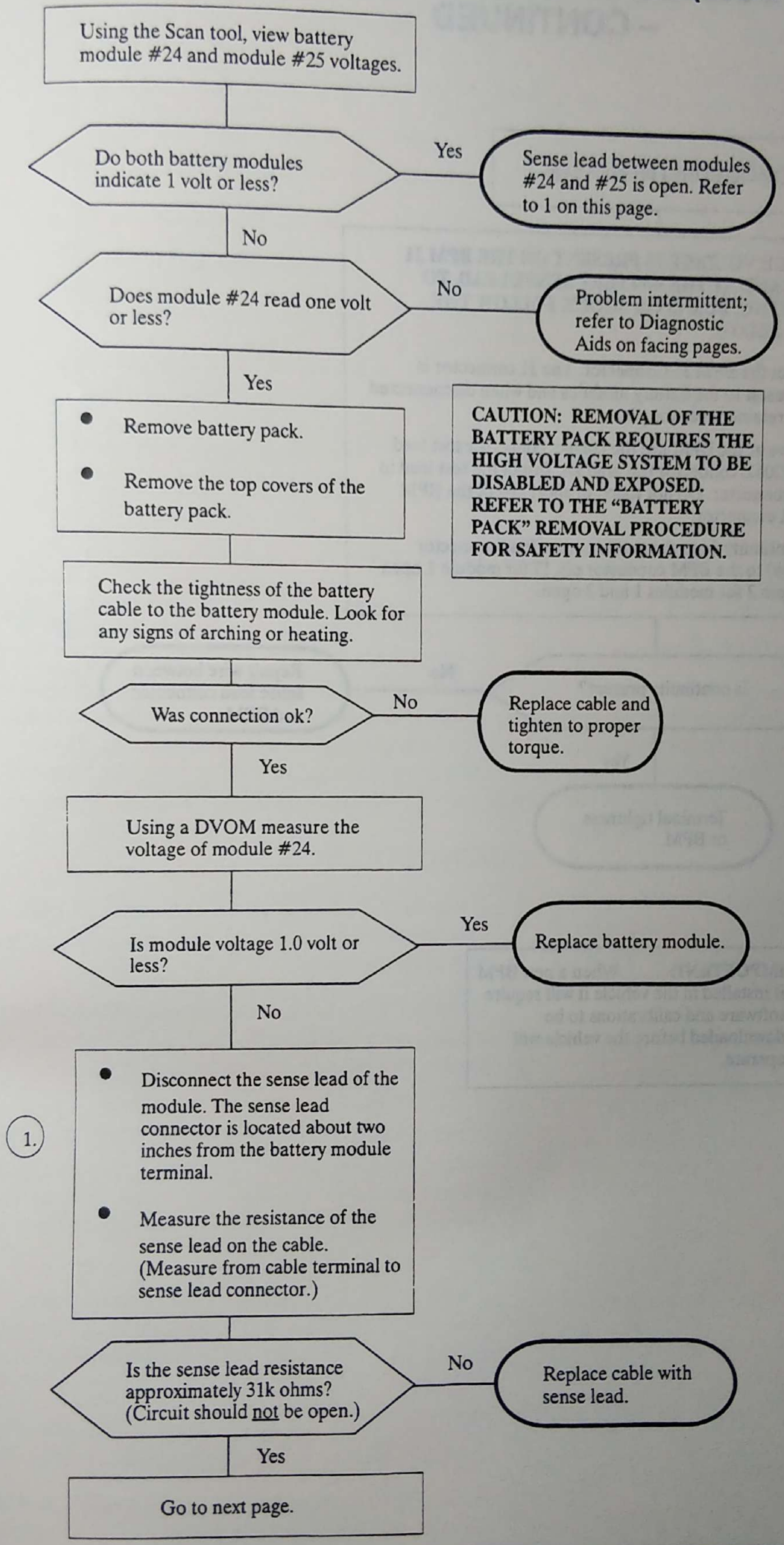
- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:
  1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
  2. Under "HIGH" discharge current (Heavy Load).
  3. When battery module state of charge (SOC) is "LOW."
- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

CS CamScanner

DTC 185
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #24)

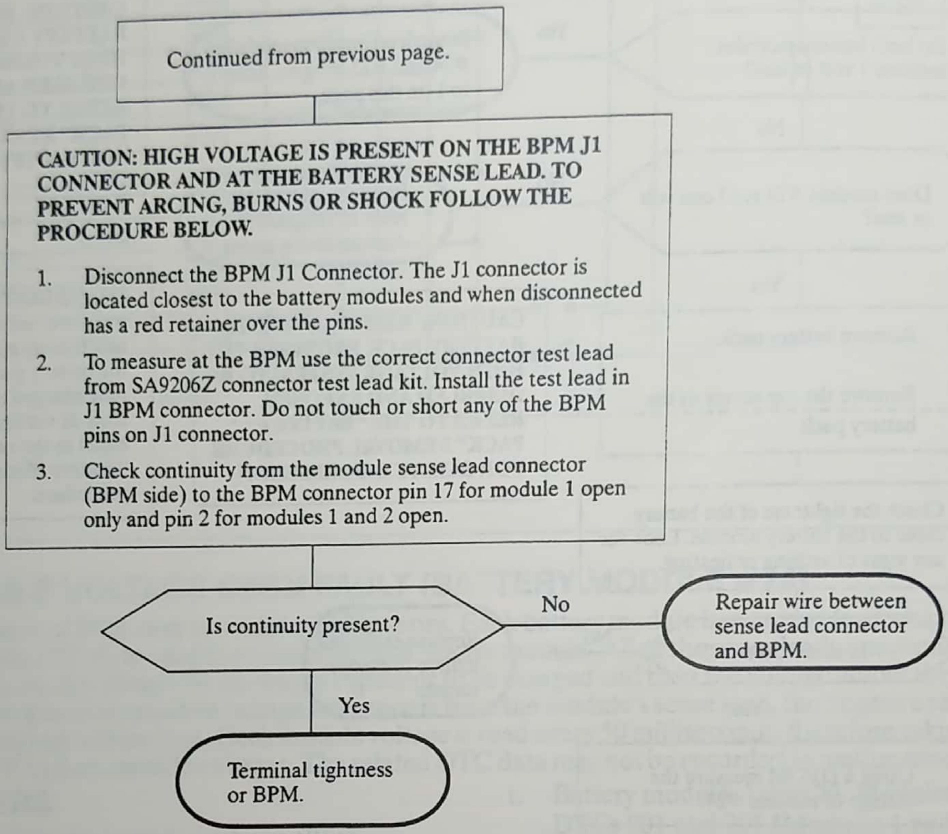

Using the Scan tool, view battery module #24 and module #25 voltages.
Do both battery modules indicate 1 volt or less?
Yes
Sense lead between modules #24 and #25 is open. Refer to 1 on this page.
No
Does module #24 read one volt or less?
No
Problem intermittent; refer to Diagnostic Aids on facing pages.
Yes
Remove battery pack.
Remove the top covers of the battery pack.
Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.
Was connection ok?
No
Replace cable and tighten to proper torque.
Yes
Using a DVOM measure the voltage of module #24.
Is module voltage 1.0 volt or less?
Yes
Replace battery module.
No
1.
Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)
Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)
No
Replace cable with sense lead.
Yes
Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 185
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #24) – CONTINUED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CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

Is continuity present?

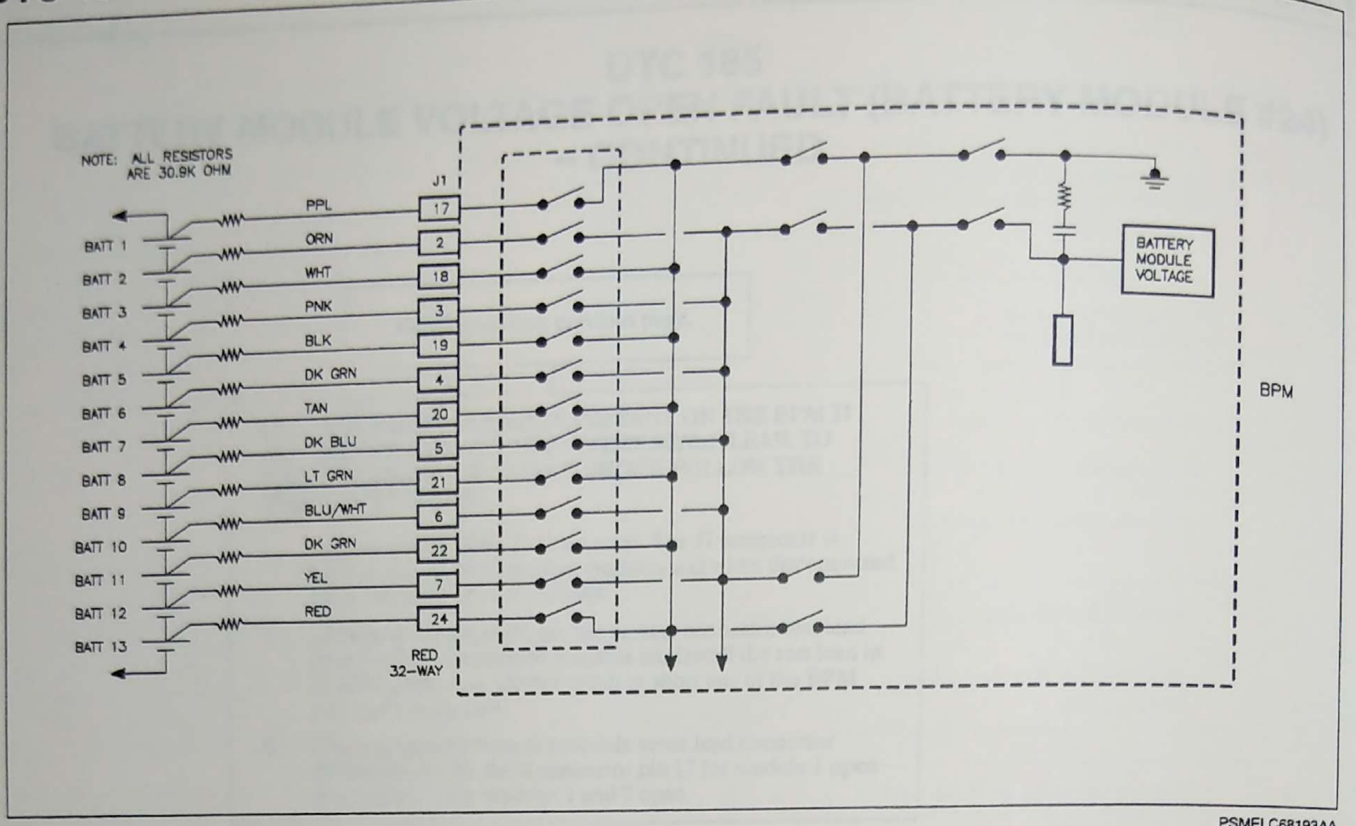
Repair wire between sense lead connector and BPM.

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 187 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #24)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #24: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

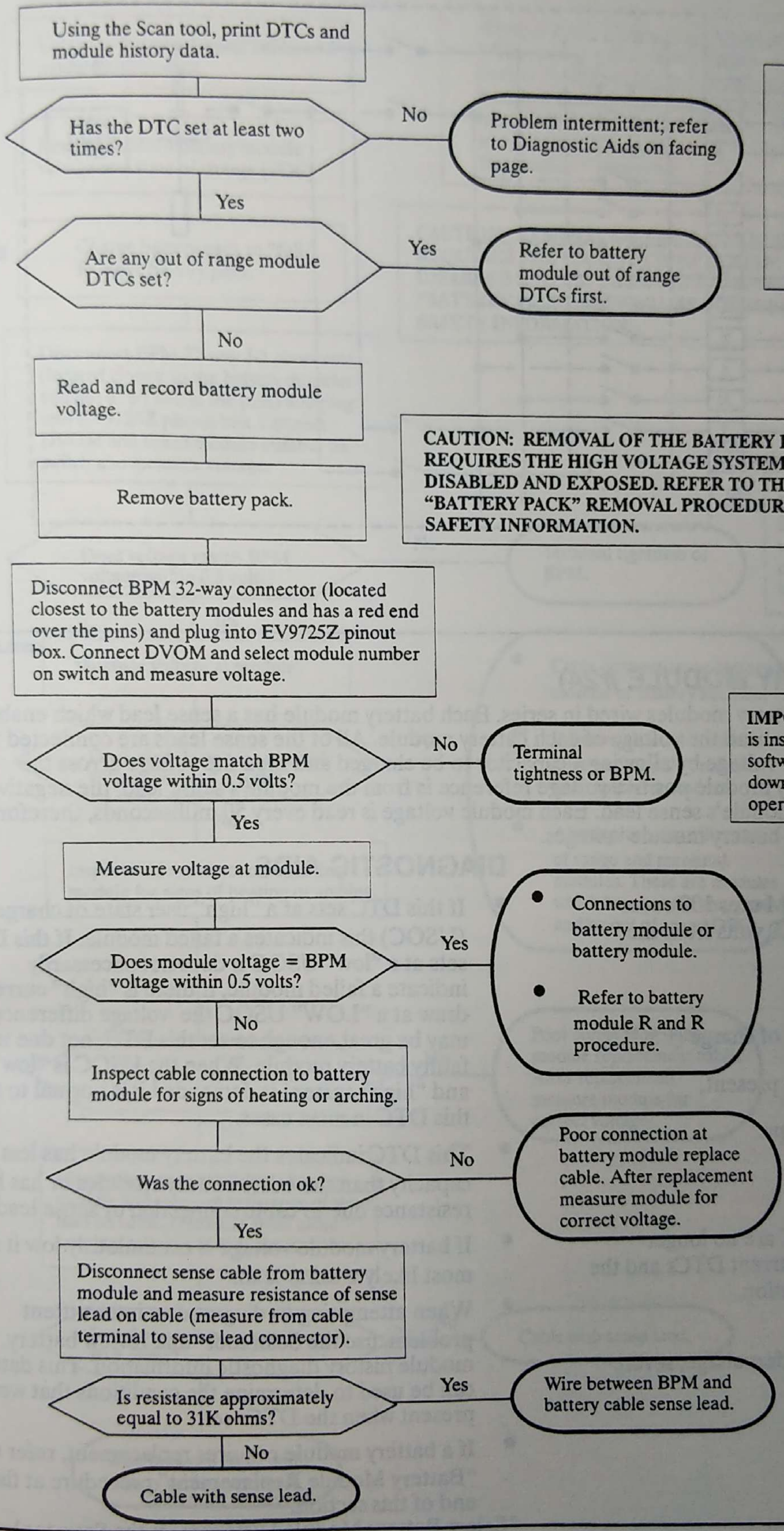
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

DTC 187
MARGINAL (BATTERY MODULE #24)

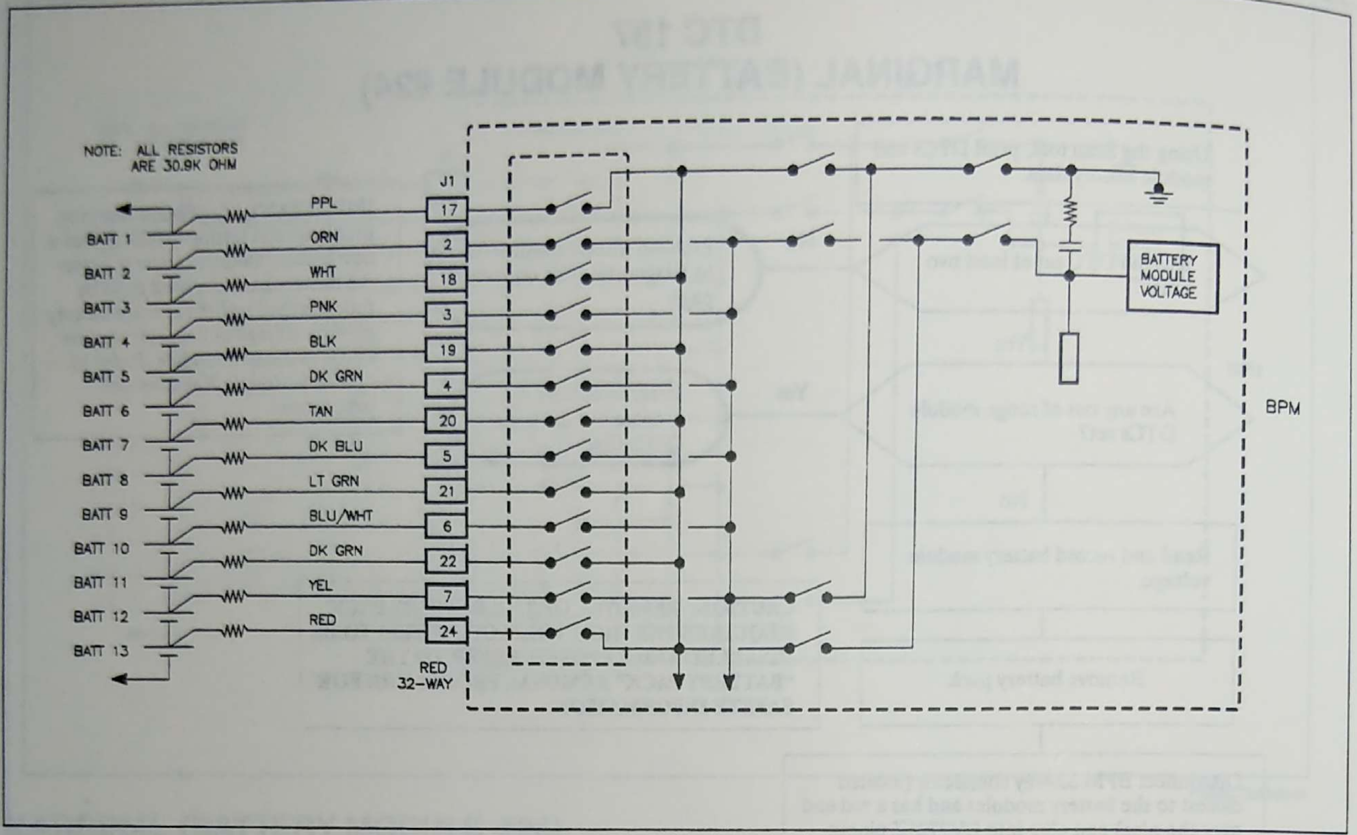

Using the Scan tool, print DTCs and module history data.
Has the DTC set at least two times?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any out of range module DTCs set?
Yes
Refer to battery module out of range DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
Connections to battery module or battery module.
Refer to battery module R and R procedure.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).
Is resistance approximately equal to 31K ohms?
Yes
Wire between BPM and battery cable sense lead.
No
Cable with sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 188 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #24)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #24: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

*Select Battery Module History from the Scan tool BPM menu.

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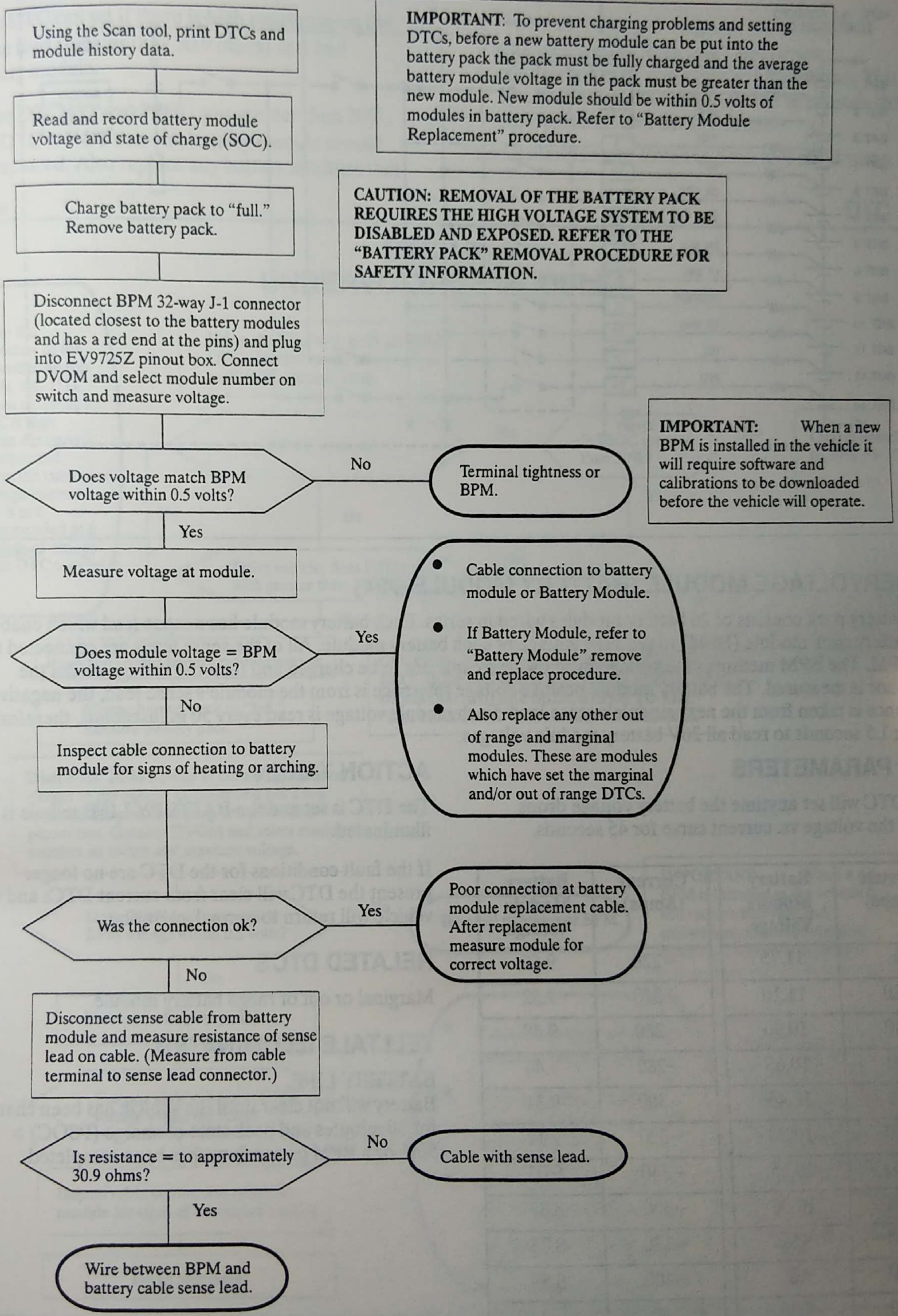
DTC 188

OUT OF RANGE (BATTERY MODULE #24)



IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

Using the Scan tool, print DTCs and module history data.

Read and record battery module voltage and state of charge (SOC).

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Cable connection to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Poor connection at battery module replacement cable. After replacement measure module for correct voltage.

Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)

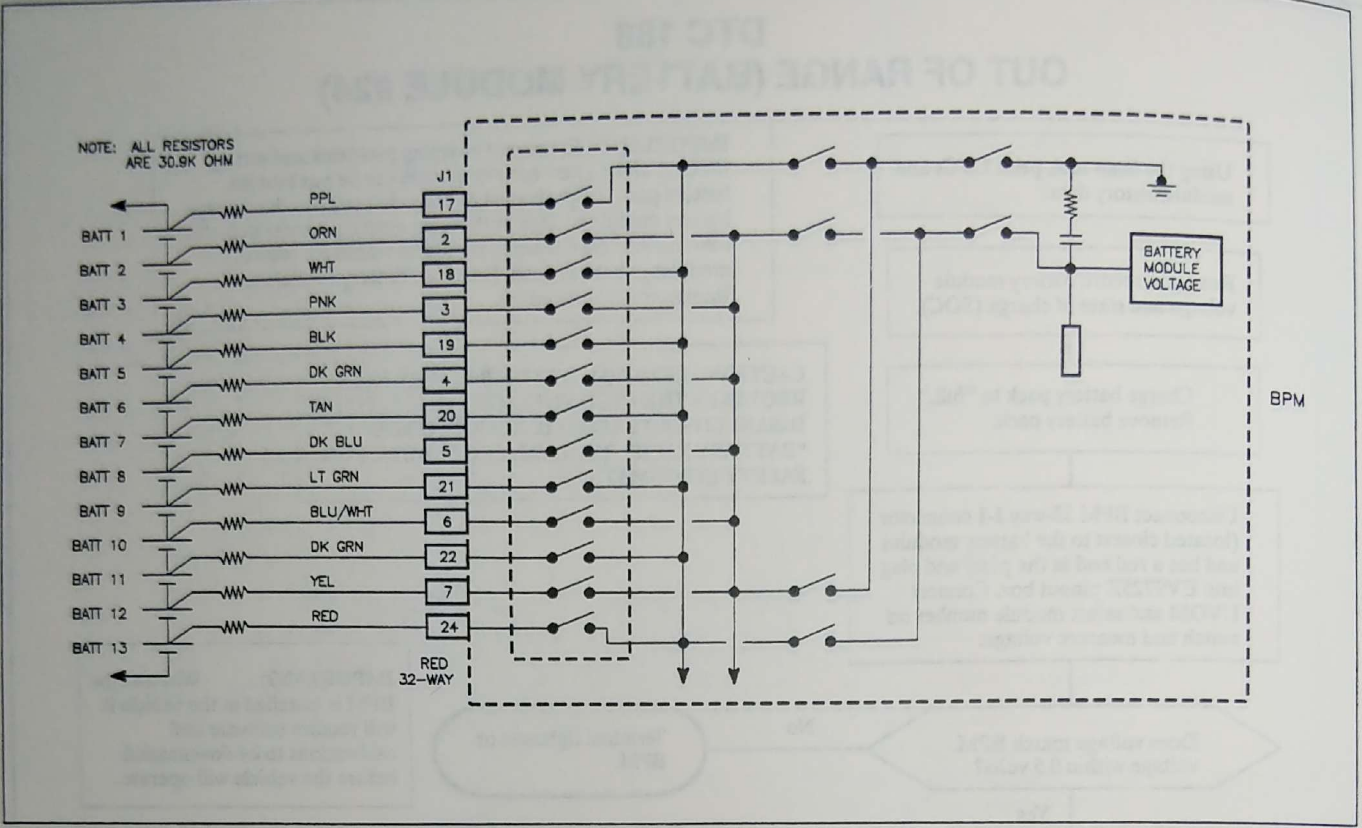
Is resistance = to approximately 30.9 ohms?

Cable with sense lead.

Wire between BPM and battery cable sense lead.

CS CamScanner

DTC 189 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
J1
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #24)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage
0	11.75
−20	11.10
−40	10.90
−60	10.65
−80	10.45
−100	10.30
−120	10.15
−140	10.00
−160	9.90
−180	9.80
−200	9.70
−220	9.60
−240	9.52
−260	9.48
−280	9.44
−300	9.31
−320	9.17
−340	9.03
−360	8.87
−380	8.73
−400	8.59

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

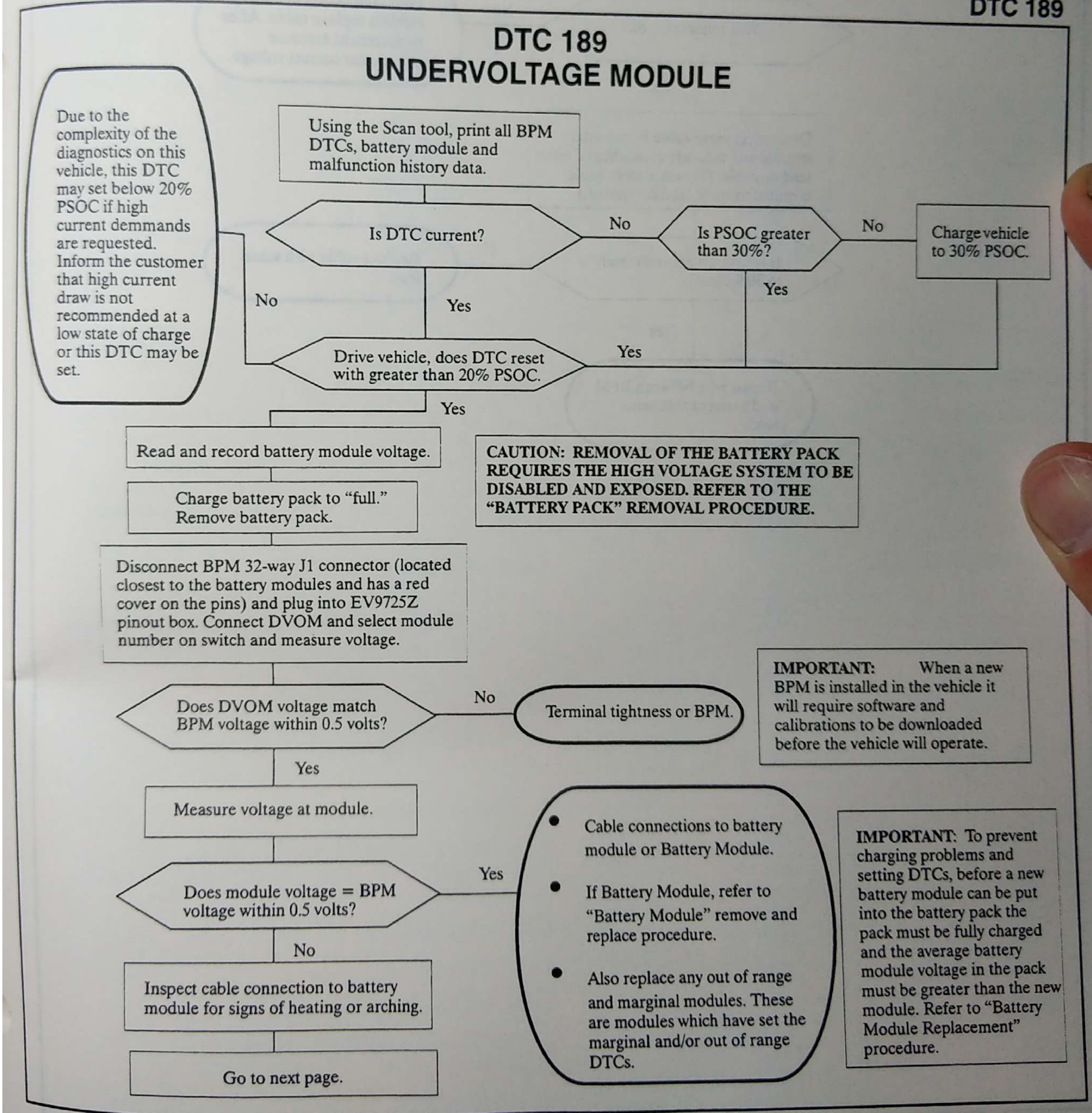
TELLTALE ILLUMINATED

BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below zero percent user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.



DTC 189
UNDERVOLTAGE MODULE

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

Using the Scan tool, print all BPM DTCs, battery module and malfunction history data.

Is DTC current?

Is PSOC greater than 30%?

Charge vehicle to 30% PSOC.

Drive vehicle, does DTC reset with greater than 20% PSOC.

Read and record battery module voltage.

Charge battery pack to "full." Remove battery pack.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

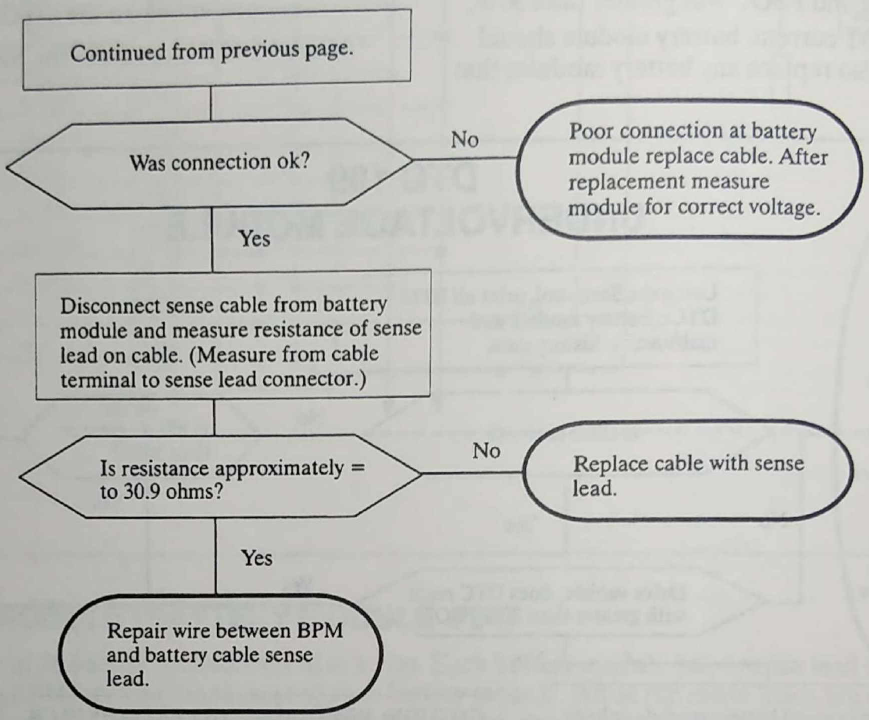
- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

Inspect cable connection to battery module for signs of heating or arching.

Go to next page.

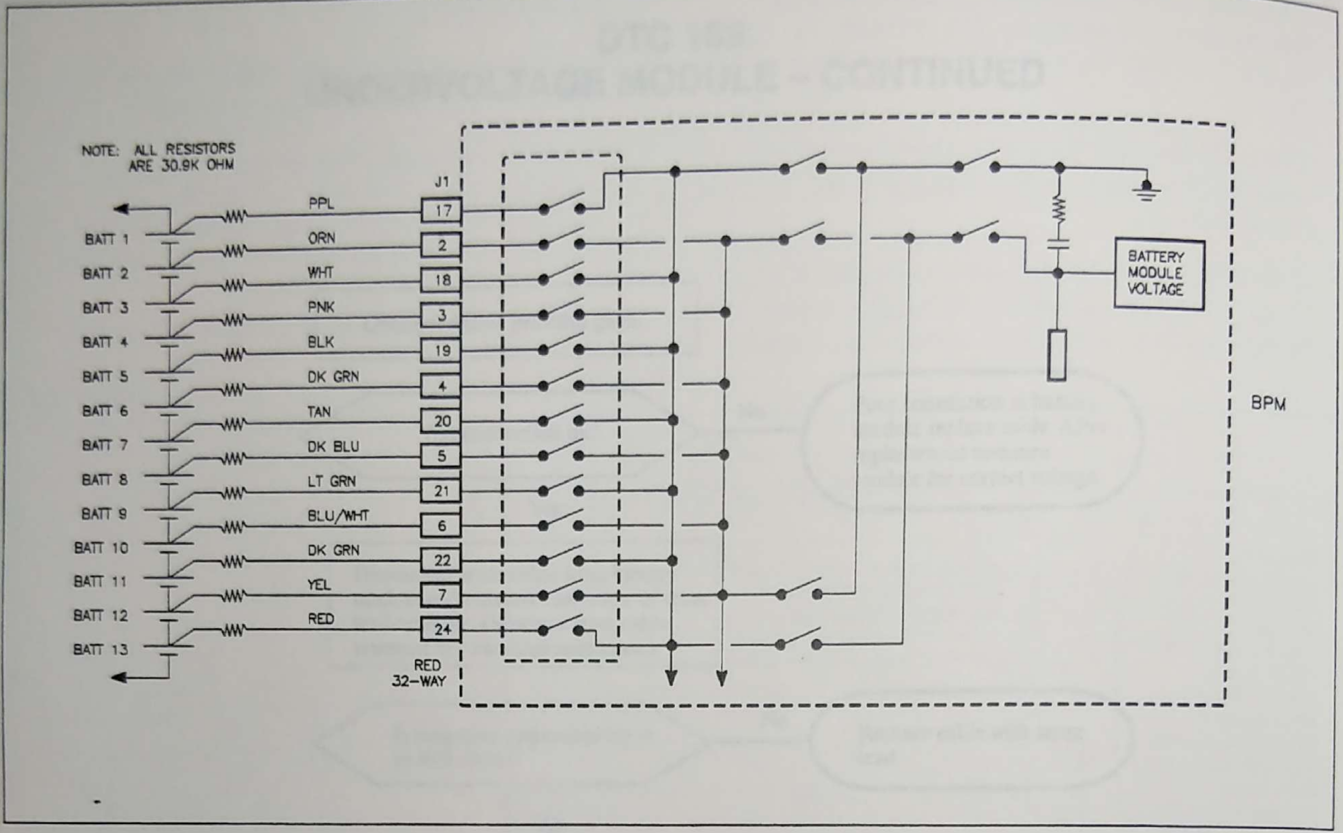
DTC 189
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

CS CamScanner

NOTES

DTC 190 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #24)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

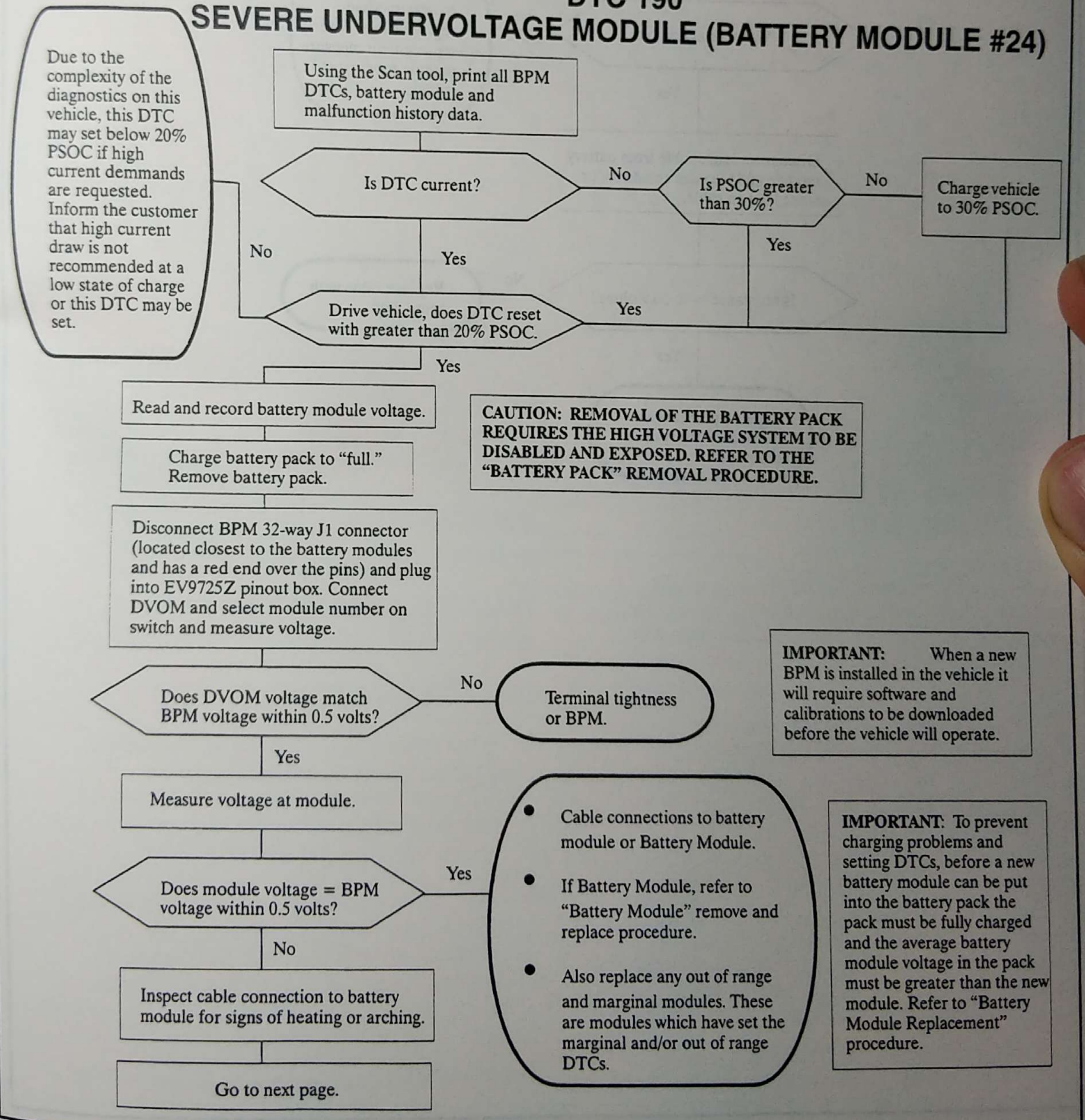
DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches zero percent user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 190

DTC 190
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #24)

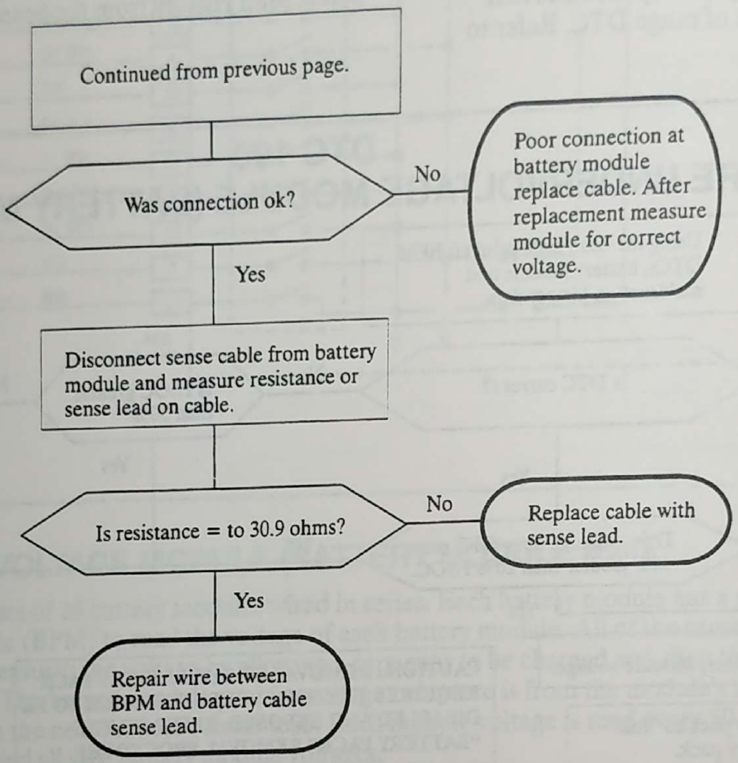

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and malfunction history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
Yes
No
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

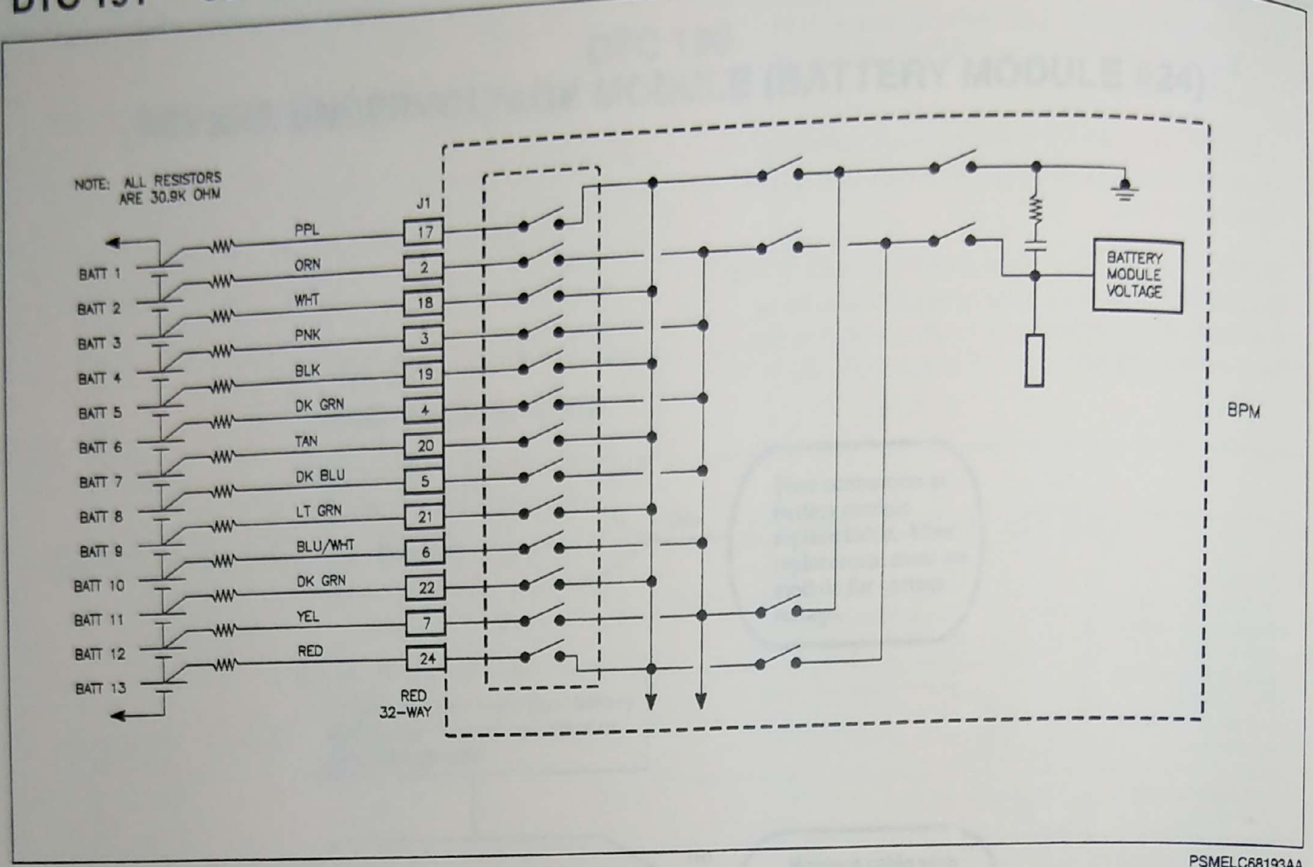
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 190
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #24)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 191 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #24)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

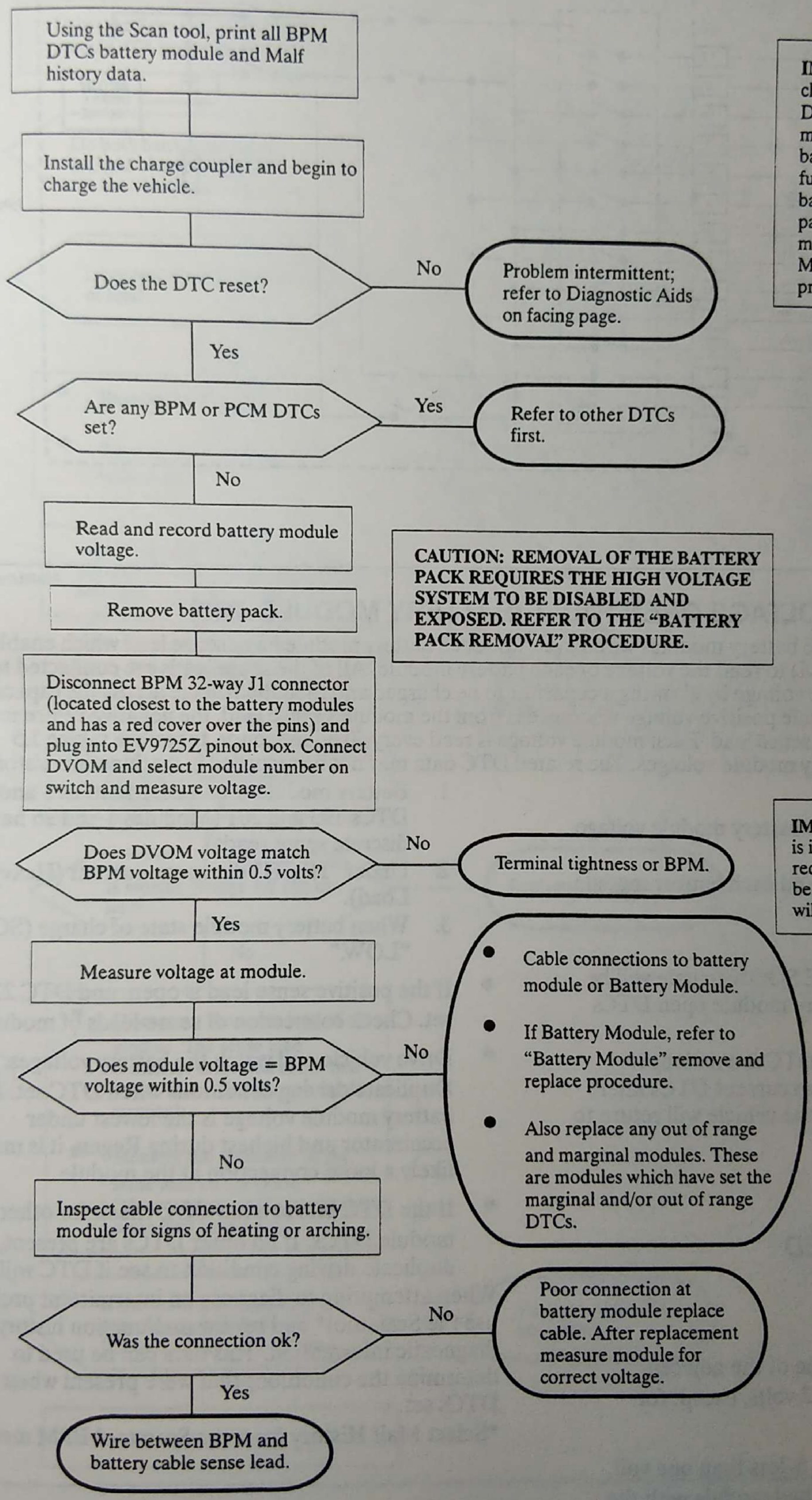
SERVICE NOW and REDUCED PERFORMANCE

DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

DTC 191
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #24)

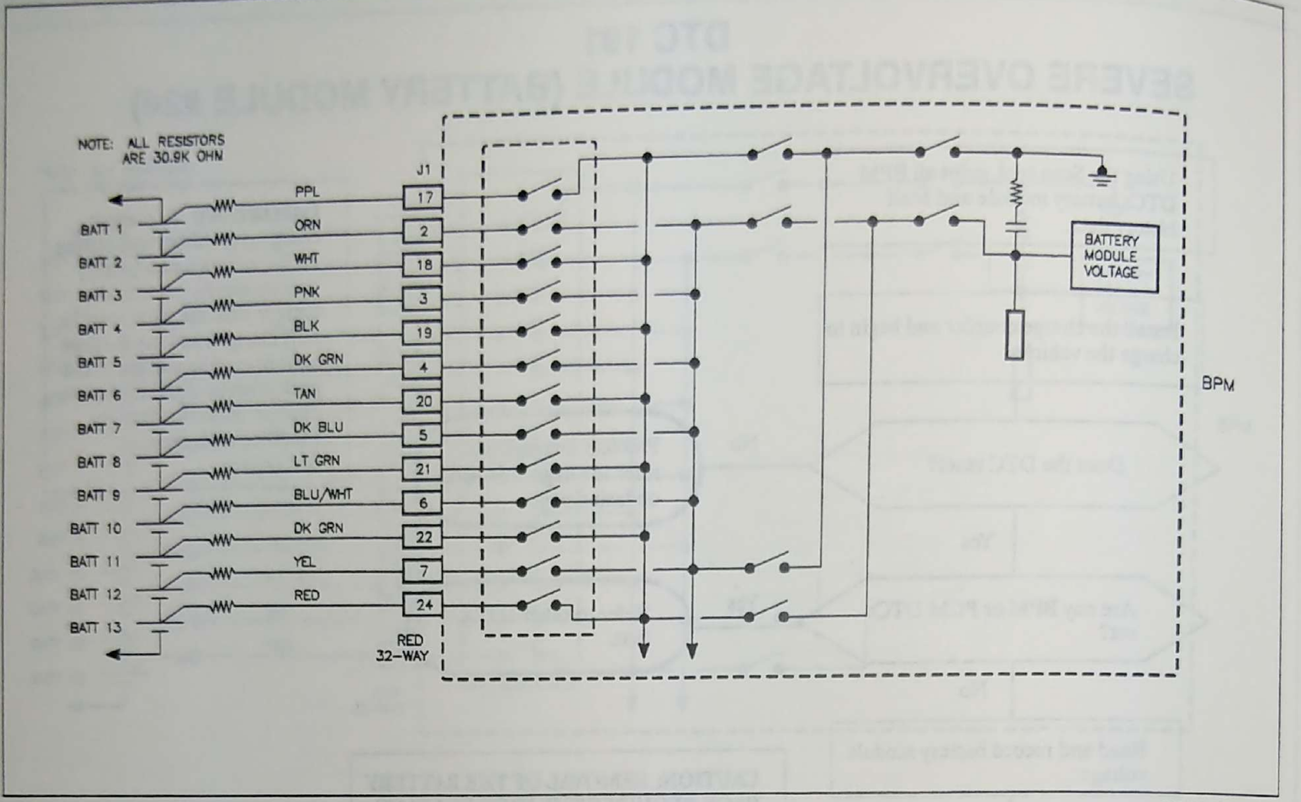

Using the Scan tool, print all BPM DTCs battery module and Malf history data.
Install the charge coupler and begin to charge the vehicle.
Does the DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any BPM or PCM DTCs set?
Yes
Refer to other DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
No
Cable connections to battery module or Battery Module.
If Battery Module, refer to "Battery Module" remove and replace procedure.
Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 193 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #25)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:

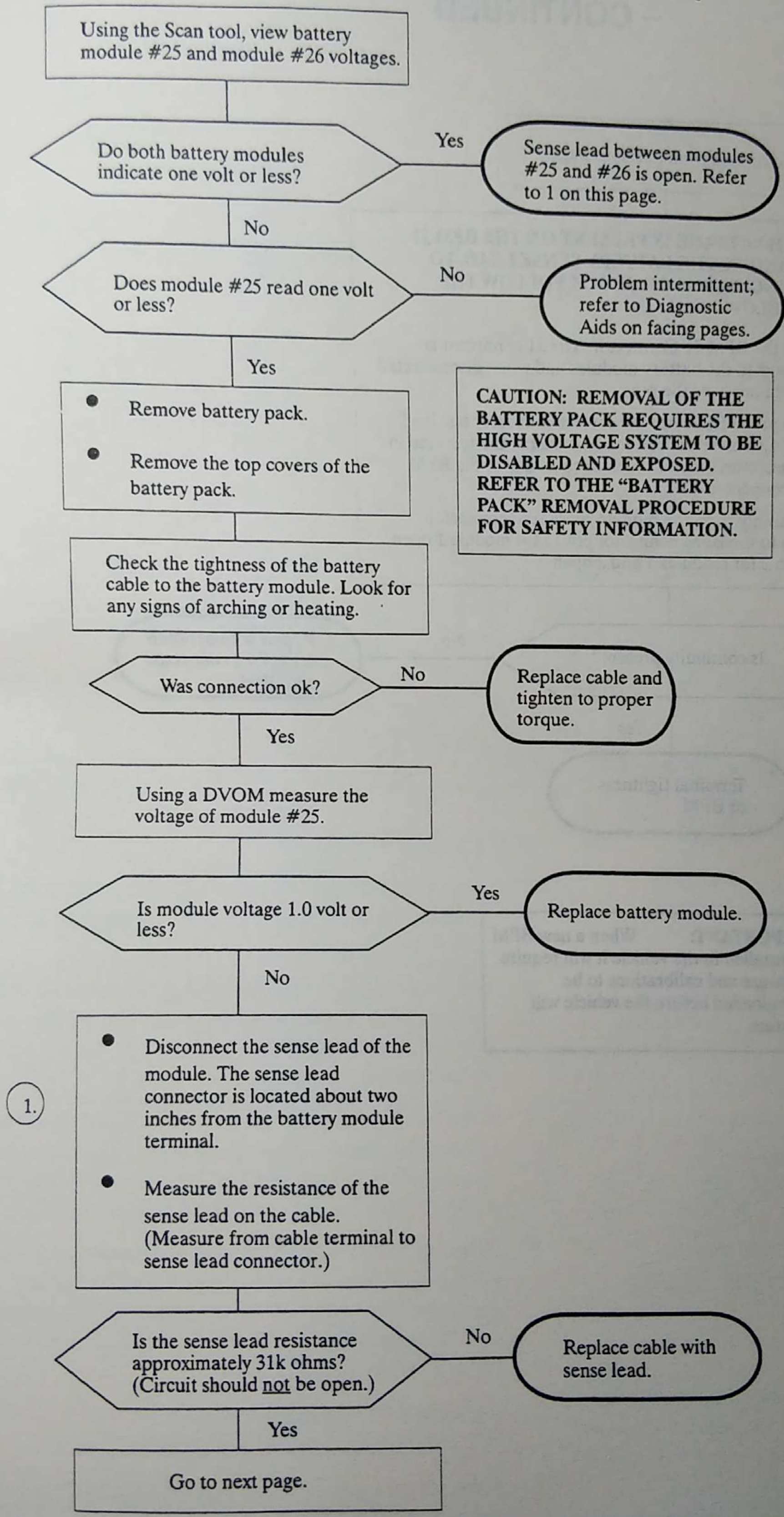
  1. Battery module 1 and 26. Modules 1 and 26, DTCs 193 and 201 (Modules 1 and 26 have discrete sense reads).
  2. Under "HIGH" discharge current (Heavy Load).
  3. When battery module state of charge (SOC) is "LOW."

- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 193
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #25)


Using the Scan tool, view battery module #25 and module #26 voltages.
Do both battery modules indicate one volt or less?
Yes
Sense lead between modules #25 and #26 is open. Refer to 1 on this page.
No
Does module #25 read one volt or less?
No
Problem intermittent; refer to Diagnostic Aids on facing pages.
Yes
• Remove battery pack.
• Remove the top covers of the battery pack.
Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.
Was connection ok?
No
Replace cable and tighten to proper torque.
Yes
Using a DVOM measure the voltage of module #25.
Is module voltage 1.0 volt or less?
Yes
Replace battery module.
No
1.
• Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
• Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)
Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)
No
Replace cable with sense lead.
Yes
Go to next page.

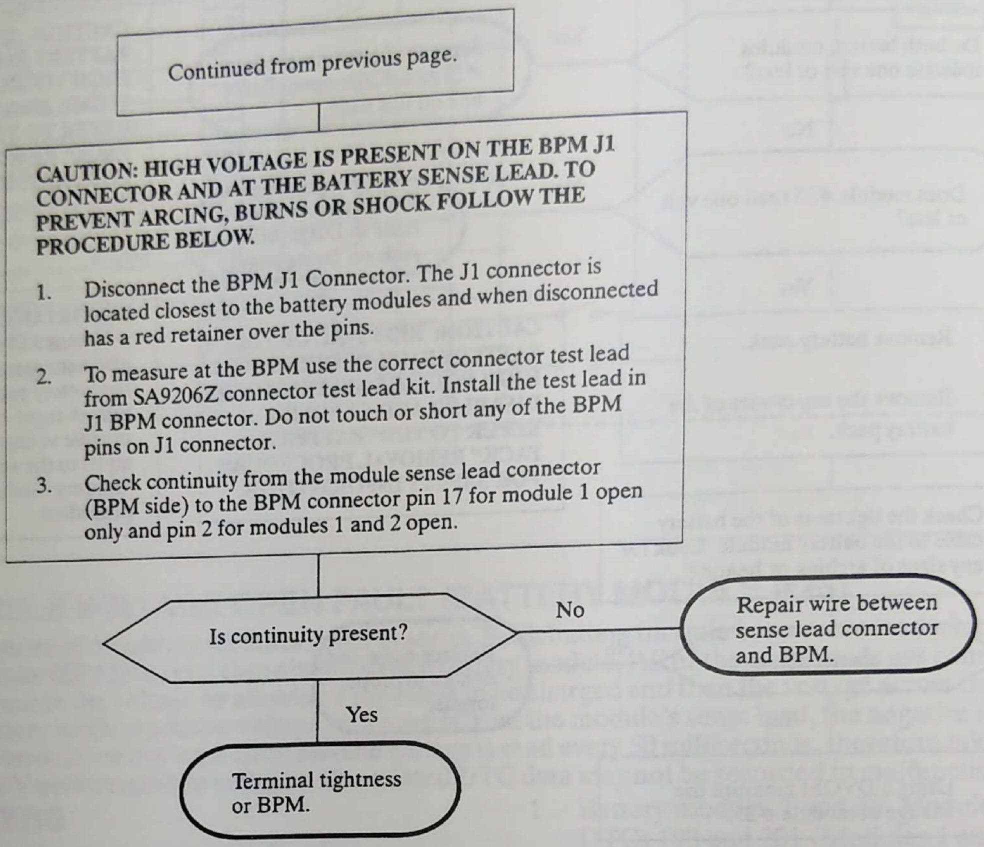
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

DTC 193

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #25) – CONTINUED



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CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

Is continuity present?

Repair wire between sense lead connector and BPM.

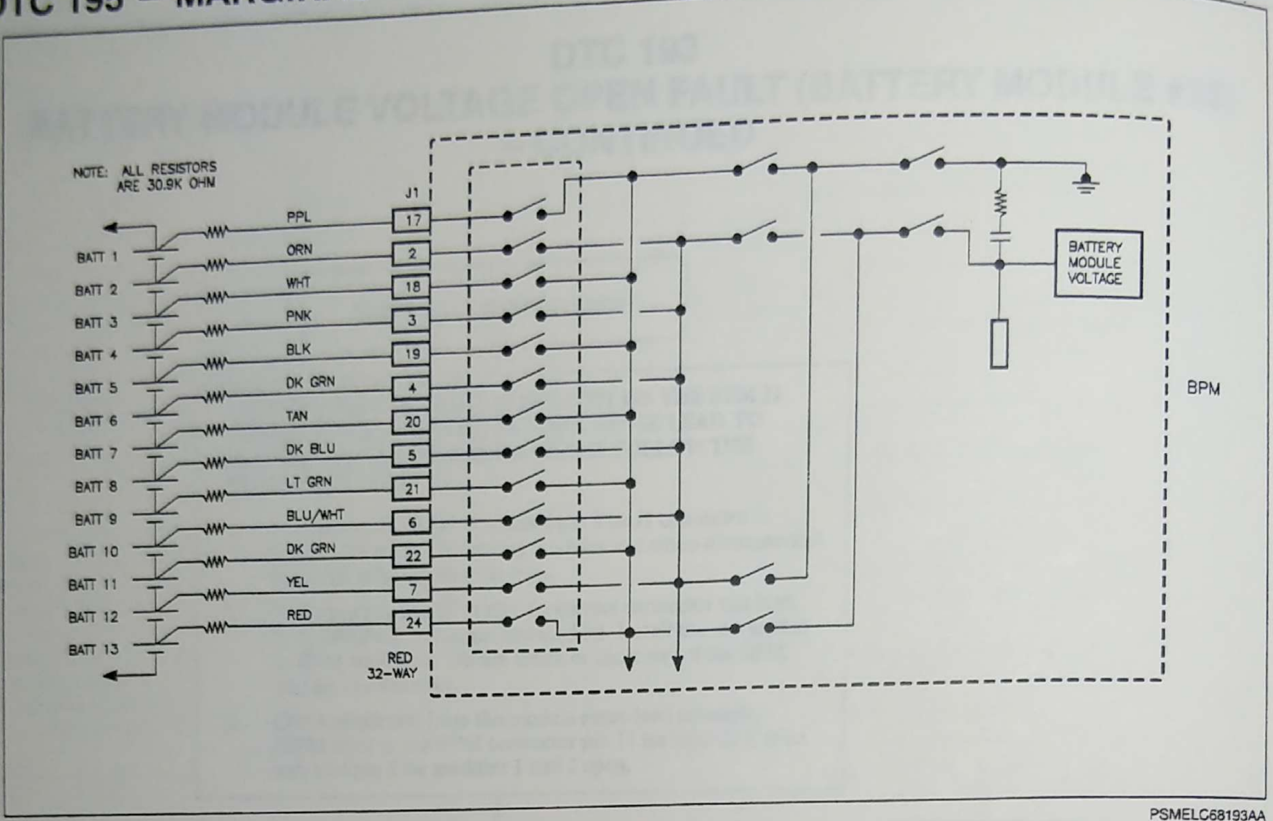
Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

CS CamScanner

NOTES

DTC 195 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #25)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #25: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

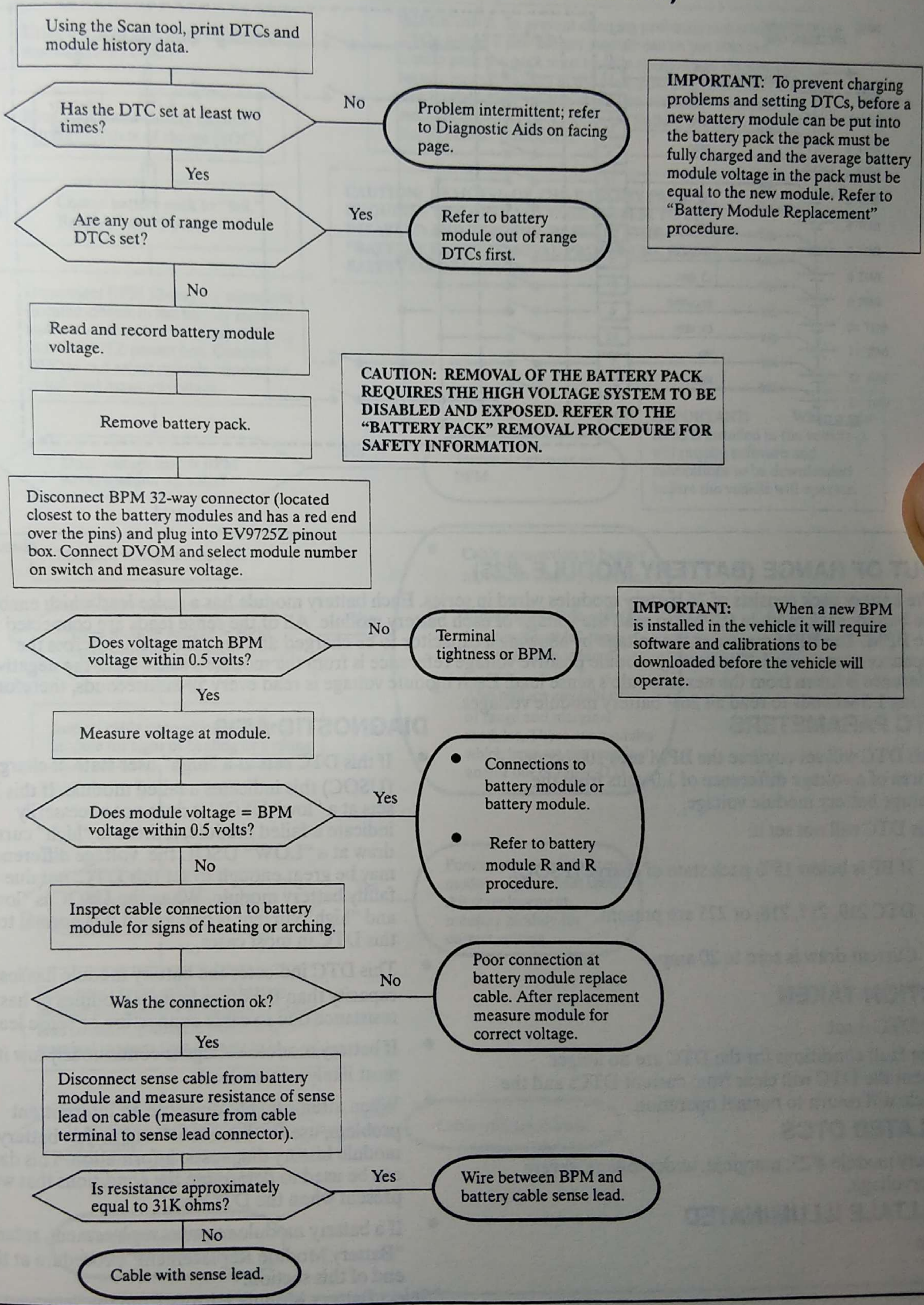
None

DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

DTC 195
MARGINAL (BATTERY MODULE #25)

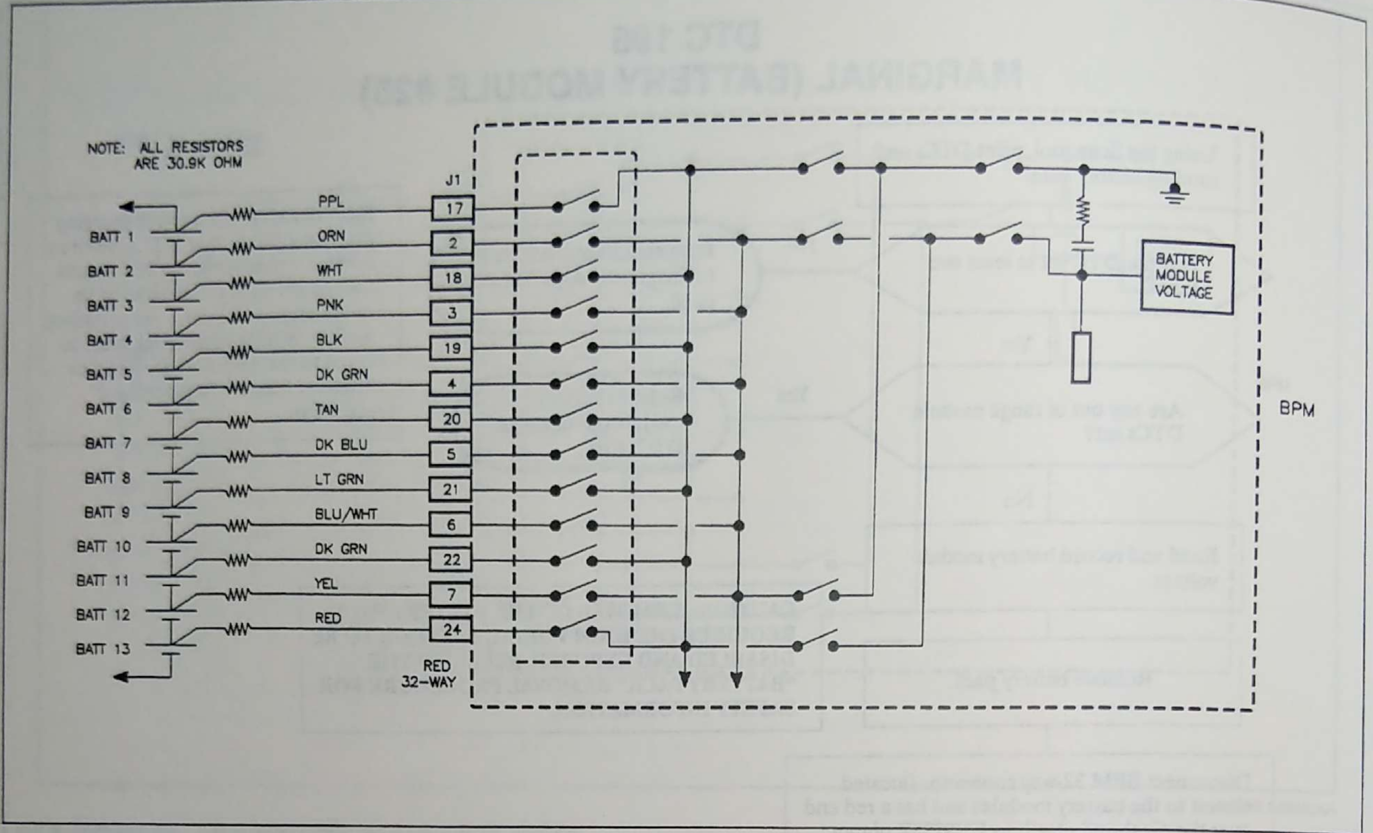

Using the Scan tool, print DTCs and module history data.
Has the DTC set at least two times?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any out of range module DTCs set?
Yes
Refer to battery module out of range DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Connections to battery module or battery module.
• Refer to battery module R and R procedure.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).
Is resistance approximately equal to 31K ohms?
Yes
Wire between BPM and battery cable sense lead.
No
Cable with sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 196 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #25)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #25: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

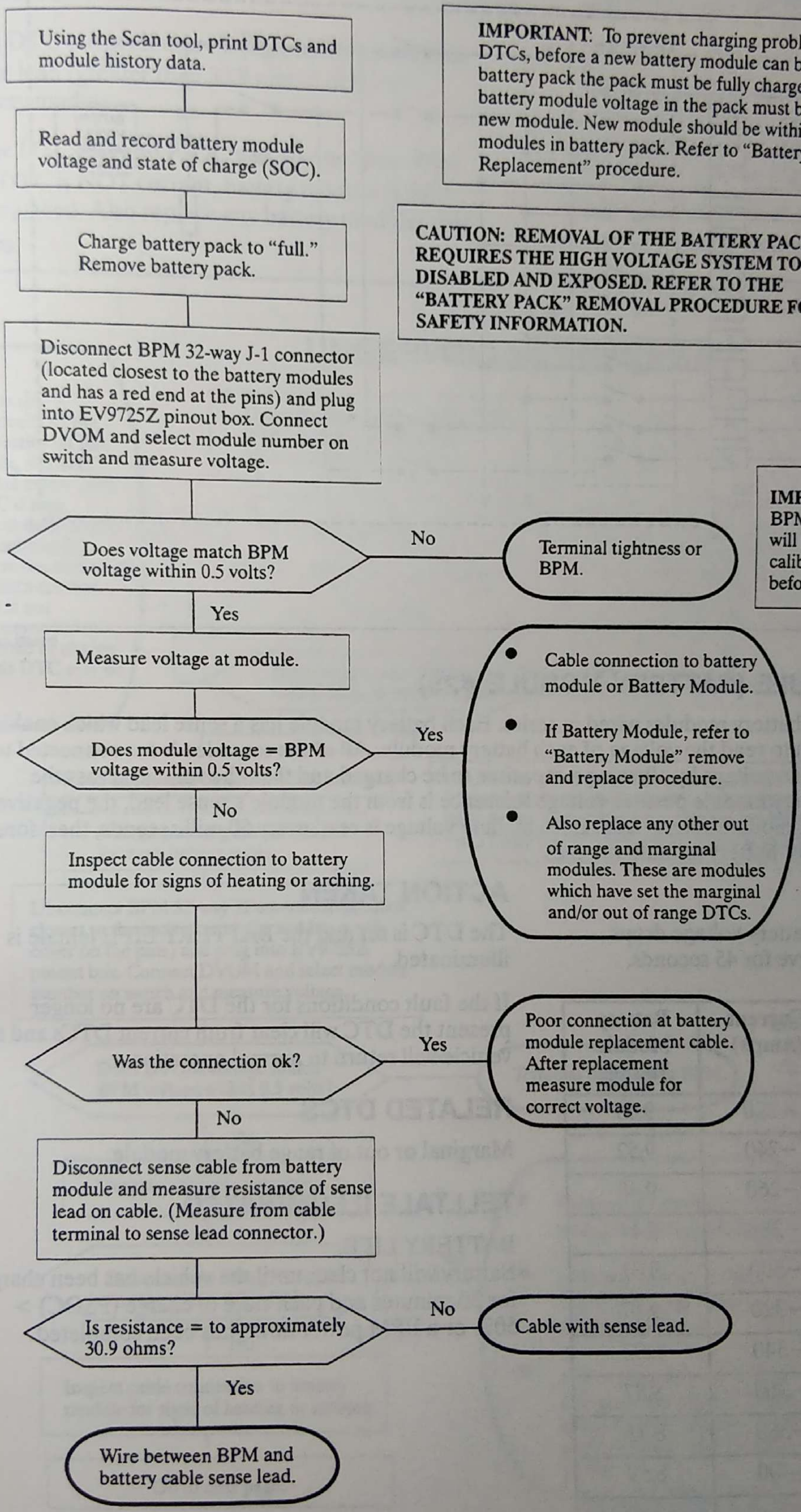
None

DIAGNOSTIC AIDS

- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

*Select Battery Module History from the Scan tool BPM menu.

DTC 196
OUT OF RANGE (BATTERY MODULE #25)

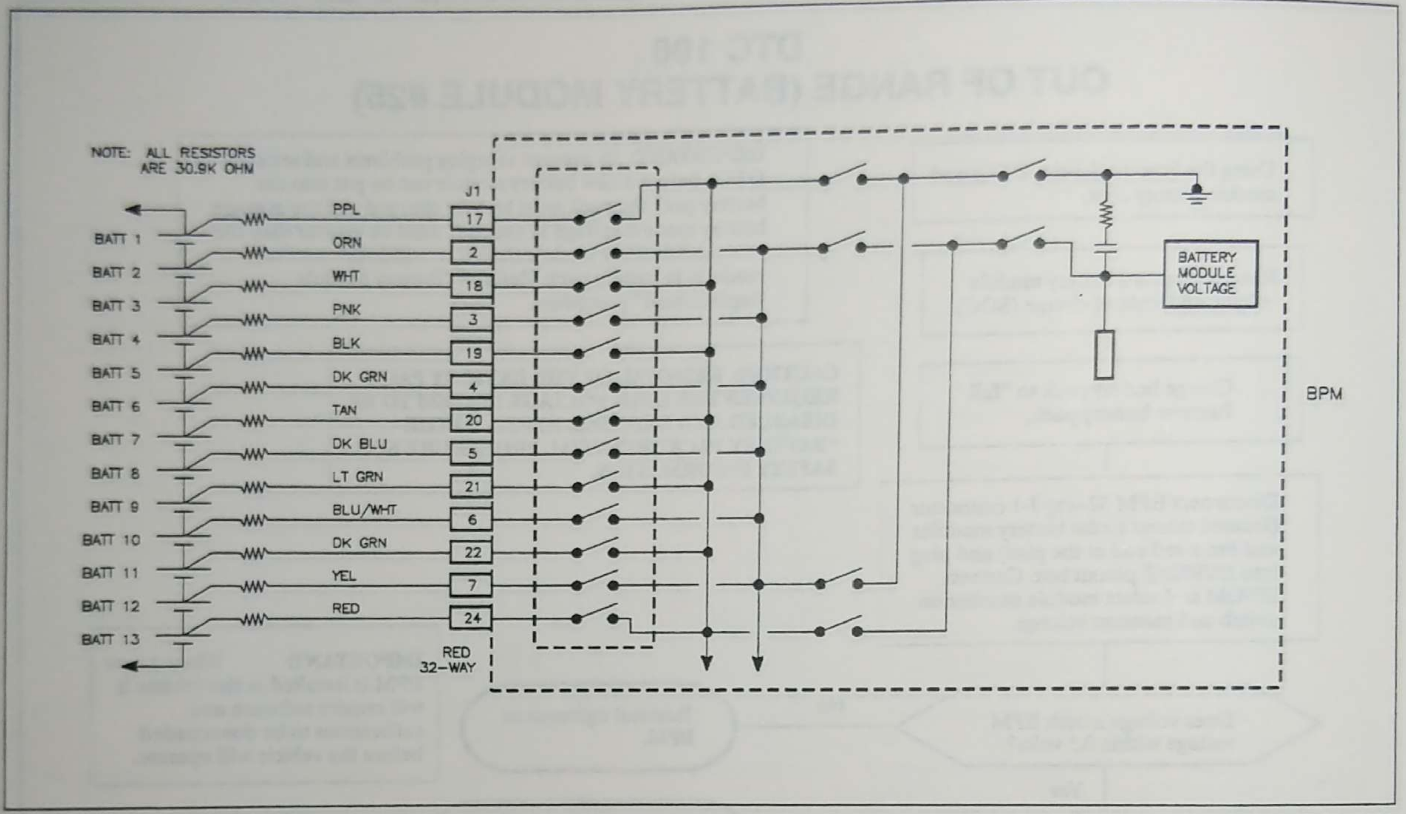

Using the Scan tool, print DTCs and module history data.
Read and record battery module voltage and state of charge (SOC).
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Cable connection to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
Yes
Poor connection at battery module replacement cable. After replacement measure module for correct voltage.
No
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance = to approximately 30.9 ohms?
No
Cable with sense lead.
Yes
Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 197 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
J1
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32–WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #25)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage	Current (Amps)	Battery Module Voltage
0	11.75	−220	9.60
−20	11.10	−240	9.52
−40	10.90	−260	9.48
−60	10.65	−280	9.44
−80	10.45	−300	9.31
−100	10.30	−320	9.17
−120	10.15	−340	9.03
−140	10.00	−360	8.87
−160	9.90	−380	8.73
−180	9.80	−400	8.59
−200	9.70		

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

TELLTALE ILLUMINATED

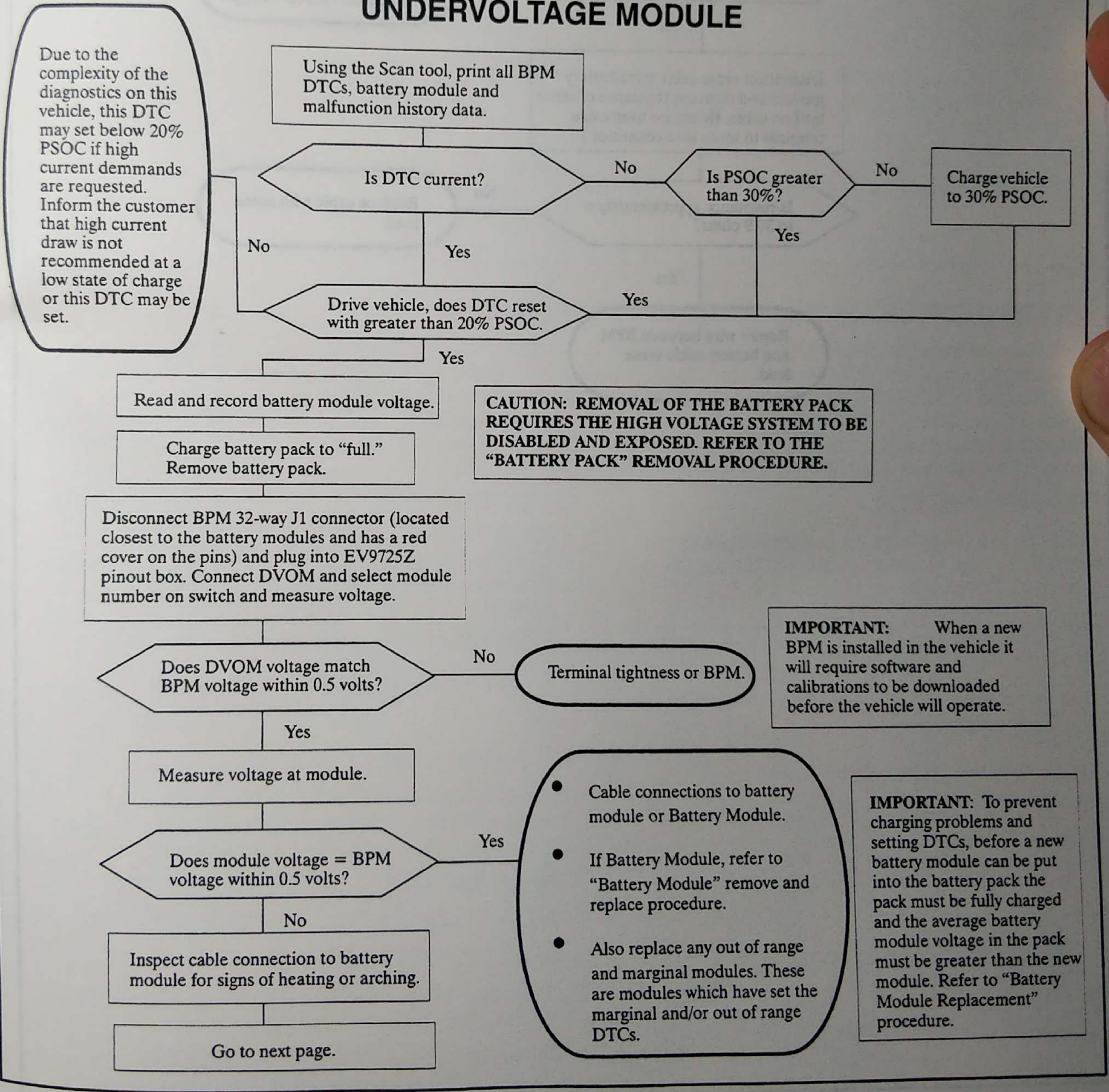
BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below zero percent user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 197
UNDERVOLTAGE MODULE


Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

Using the Scan tool, print all BPM DTCs, battery module and malfunction history data.

Is DTC current?

Is PSOC greater than 30%?

Charge vehicle to 30% PSOC.

Drive vehicle, does DTC reset with greater than 20% PSOC.

Read and record battery module voltage.

Charge battery pack to "full." Remove battery pack.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

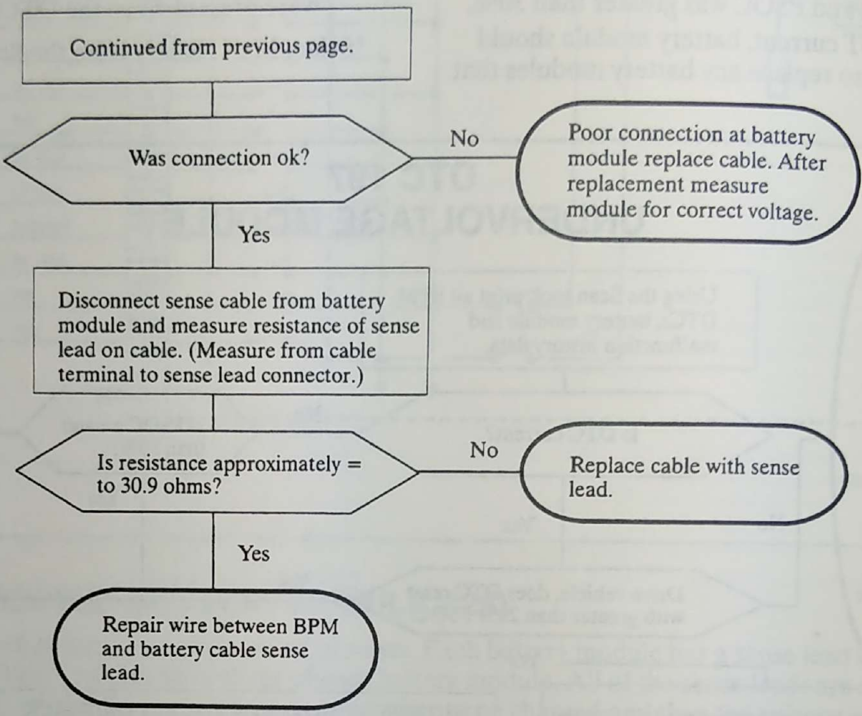
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

Inspect cable connection to battery module for signs of heating or arching.

Go to next page.

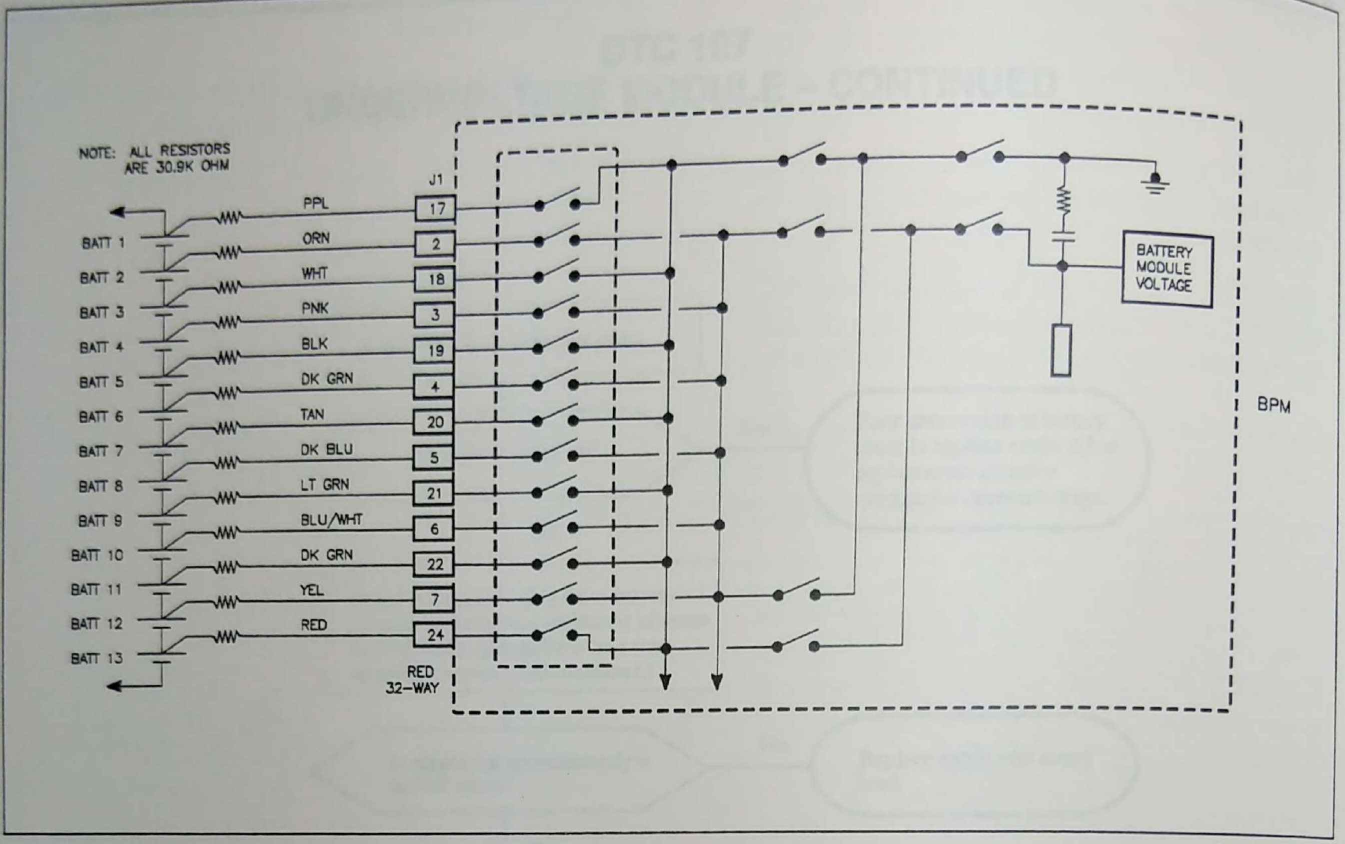
CS CamScanner

DTC 197
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 198 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #25)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

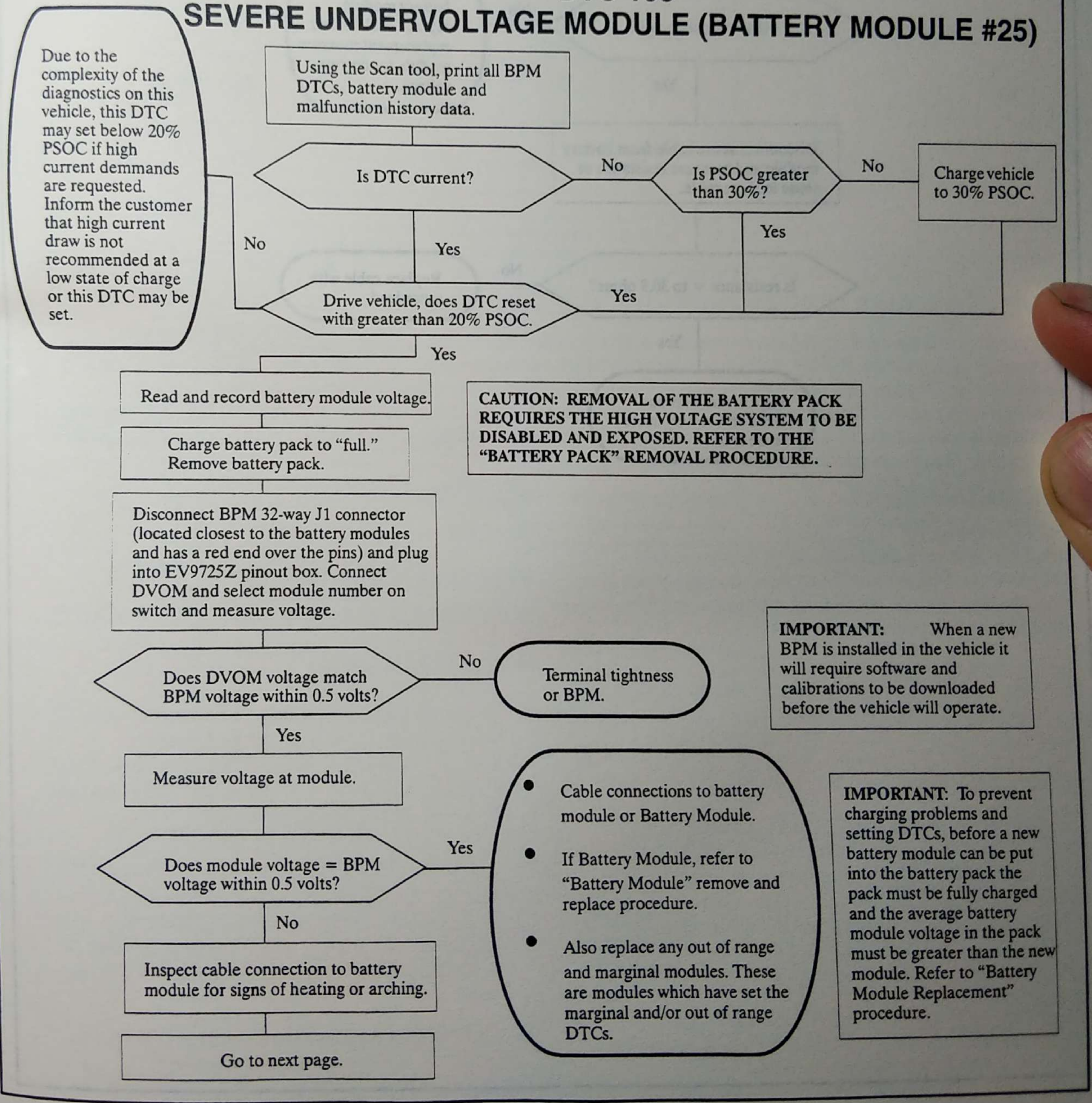
DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches zero percent user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 198

DTC 198
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #25)

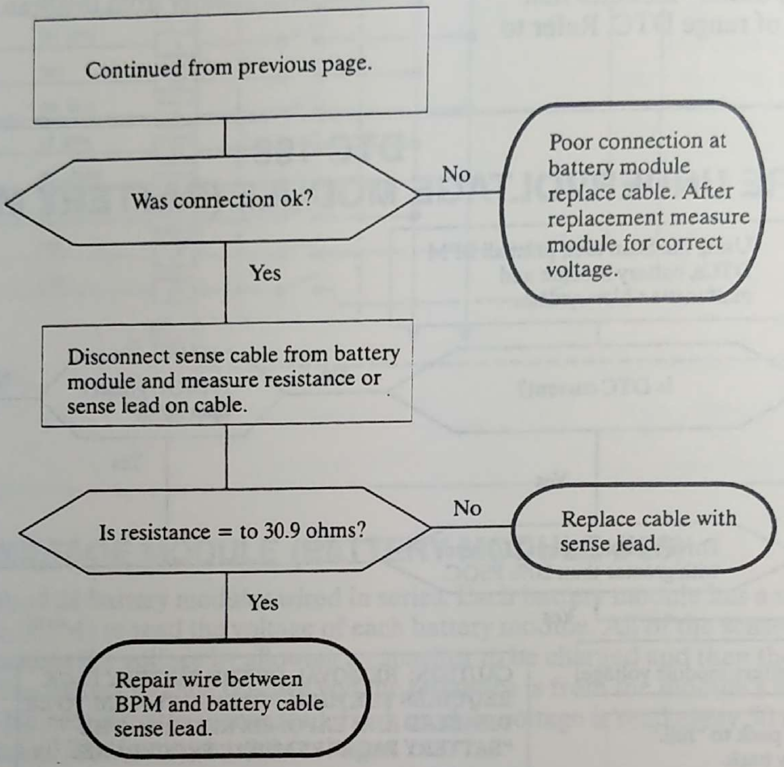

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.
Using the Scan tool, print all BPM DTCs, battery module and malfunction history data.
Is DTC current?
No
Is PSOC greater than 30%?
No
Charge vehicle to 30% PSOC.
Yes
Yes
No
Drive vehicle, does DTC reset with greater than 20% PSOC.
Yes
Yes
Read and record battery module voltage.
Charge battery pack to "full." Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

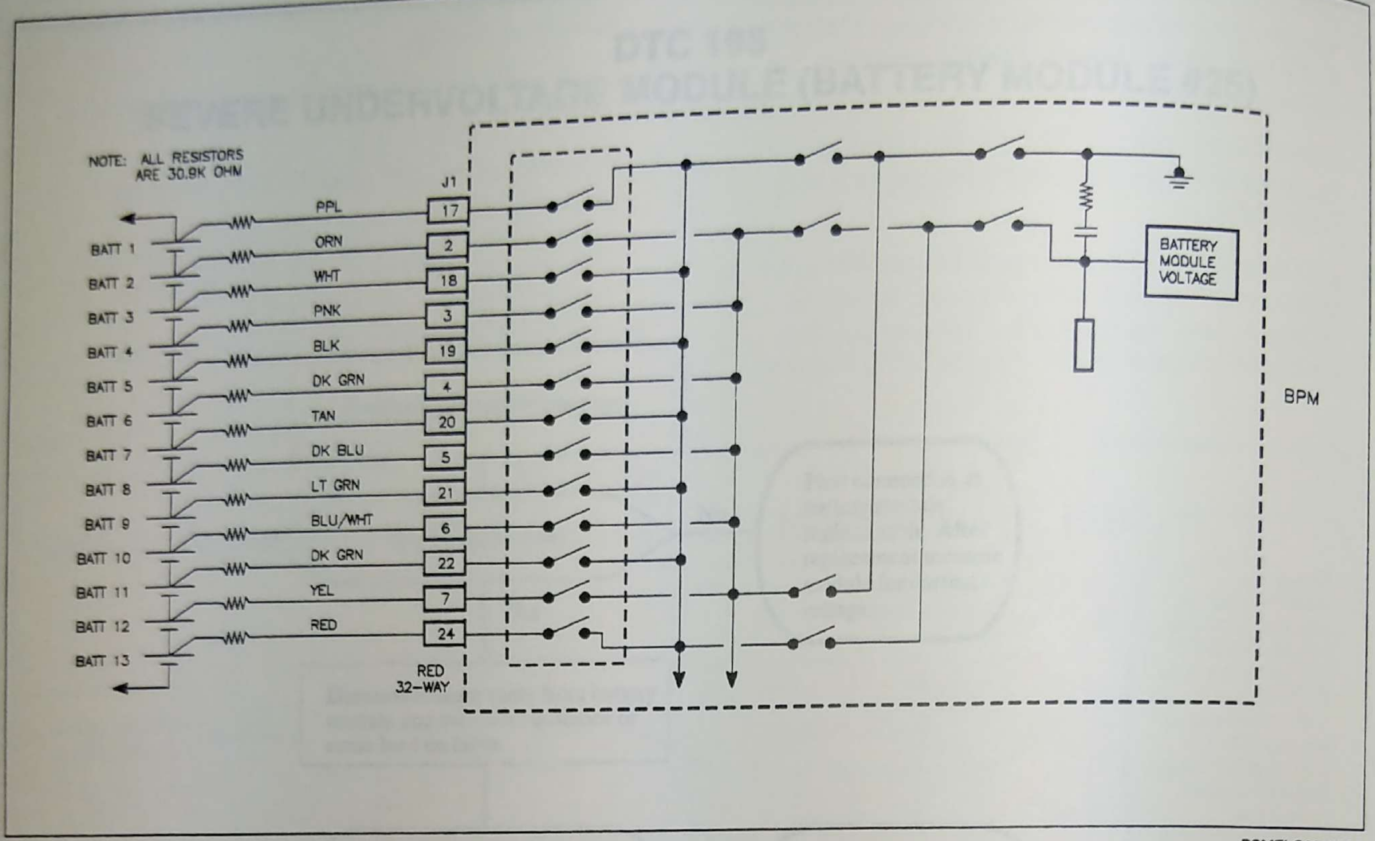
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 198
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #25)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 199 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #25)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

SERVICE NOW and REDUCED PERFORMANCE

DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

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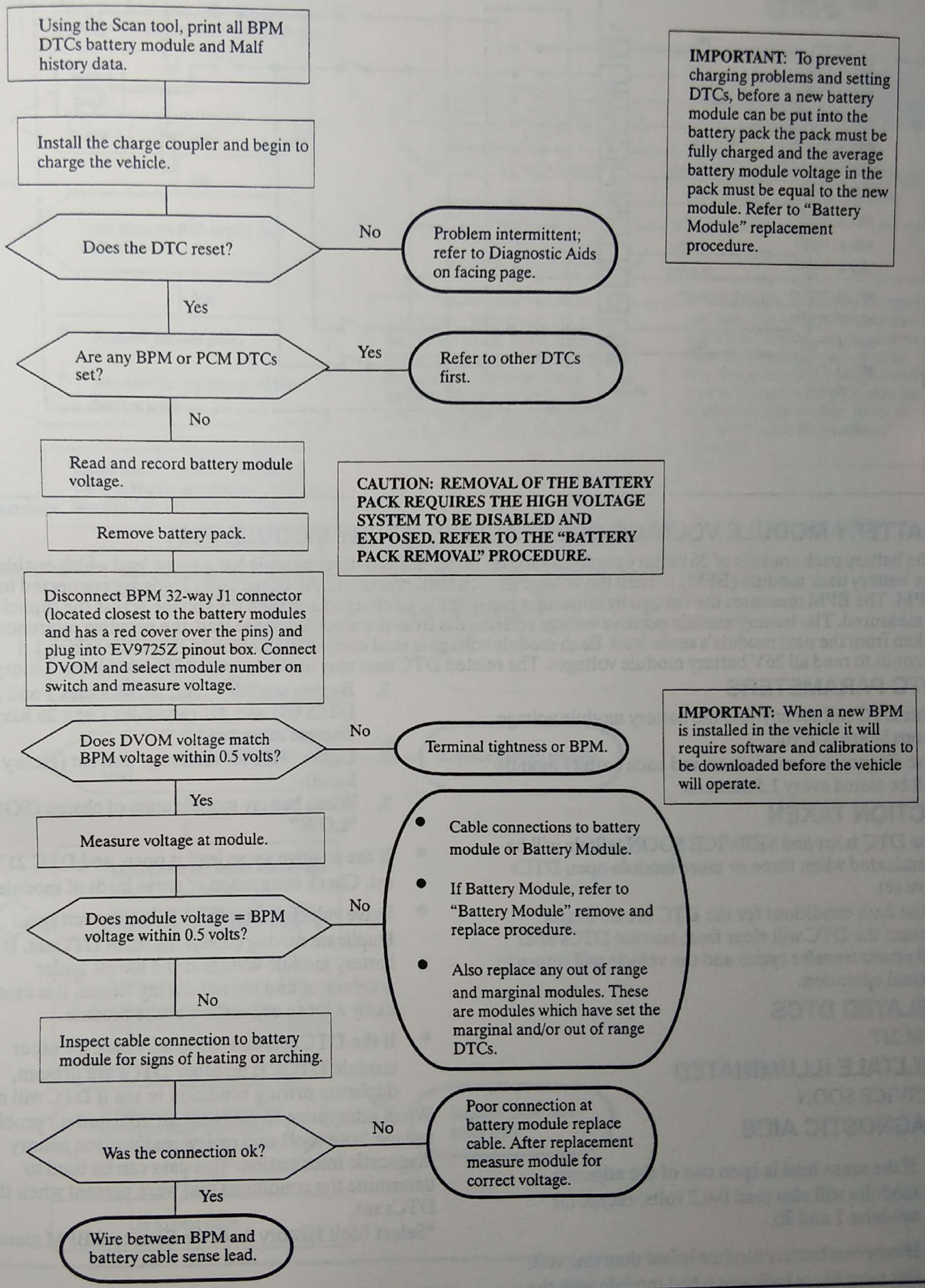
DTC 199
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #25)



Using the Scan tool, print all BPM DTCs battery module and Malf history data.

Install the charge coupler and begin to charge the vehicle.

Does the DTC reset?

No: Problem intermittent; refer to Diagnostic Aids on facing page.

Yes: Are any BPM or PCM DTCs set?

Yes: Refer to other DTCs first.

No: Read and record battery module voltage.

Remove battery pack.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

No: Terminal tightness or BPM.

Yes: Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

No:

- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

No: Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

No: Poor connection at battery module replace cable. After replacement measure module for correct voltage.

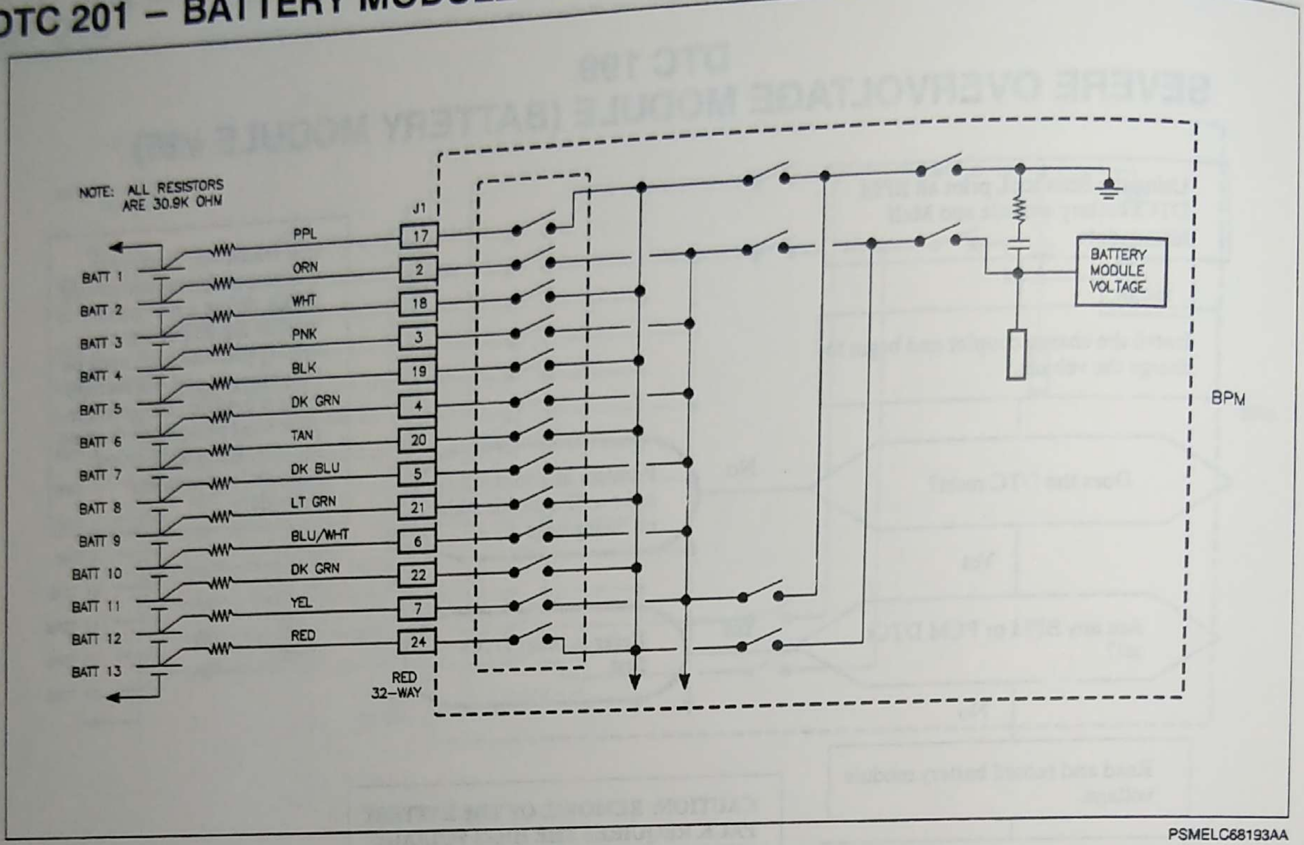
Yes: Wire between BPM and battery cable sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 201 – BATTERY MODULE VOLTAGE OPEN FAULT



PSMELC68193AA

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #26)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages. The related DTC data may not be recorded in malfunction history.

DTC PARAMETERS

This DTC will set anytime the battery module voltage drops below one volt.

The diagnostic is continuous and each battery module will be tested every 1.5 seconds.

ACTION TAKEN

The DTC is set and SERVICE SOON telltale will be illuminated when three or more module open DTCs have set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs after 100 power transfer cycles and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

- If the sense lead is open one of the adjacent modules will also read 0-0.2 volts, except for modules 1 and 26.
- If only one battery module is less than one volt, this most likely indicates a bad module with the following exceptions:

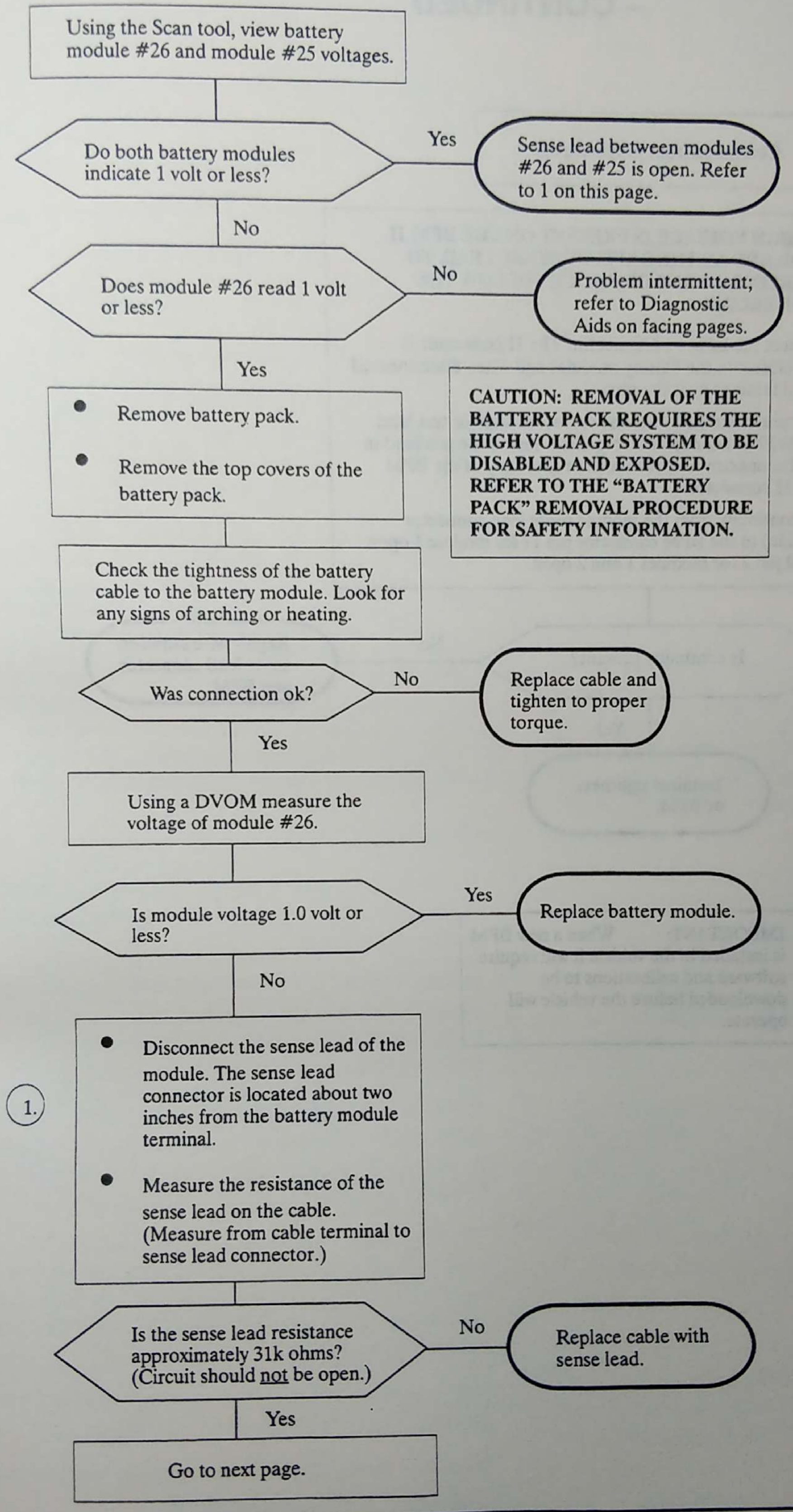
  1. Battery module 1 and 26. Modules 1 and 26, DTCs 001 and 201 (Modules 1 and 26 have discrete sense reads).
  2. Under "HIGH" discharge current (Heavy Load).
  3. When battery module state of charge (SOC) is "LOW."

- If the positive sense lead is open, and DTC 217 is set. Check connection of sense leads of module.
- Drive vehicle and watch the battery voltages. Duplicate driving conditions when DTC set. If the battery module voltage is the lowest under accelerator and highest during Regen, it is most likely a loose connection at the module.
- If the DTC sets at a low SOC check for other module DTCs. If no other DTCs are present, duplicate driving condition to see if DTC will reset.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 201
BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #26)


Using the Scan tool, view battery module #26 and module #25 voltages.
Do both battery modules indicate 1 volt or less?
Yes
Sense lead between modules #26 and #25 is open. Refer to 1 on this page.
No
Does module #26 read 1 volt or less?
No
Problem intermittent; refer to Diagnostic Aids on facing pages.
Yes
● Remove battery pack.
● Remove the top covers of the battery pack.
Check the tightness of the battery cable to the battery module. Look for any signs of arching or heating.
Was connection ok?
No
Replace cable and tighten to proper torque.
Yes
Using a DVOM measure the voltage of module #26.
Is module voltage 1.0 volt or less?
Yes
Replace battery module.
No
1.
● Disconnect the sense lead of the module. The sense lead connector is located about two inches from the battery module terminal.
● Measure the resistance of the sense lead on the cable. (Measure from cable terminal to sense lead connector.)
Is the sense lead resistance approximately 31k ohms? (Circuit should not be open.)
No
Replace cable with sense lead.
Yes
Go to next page.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

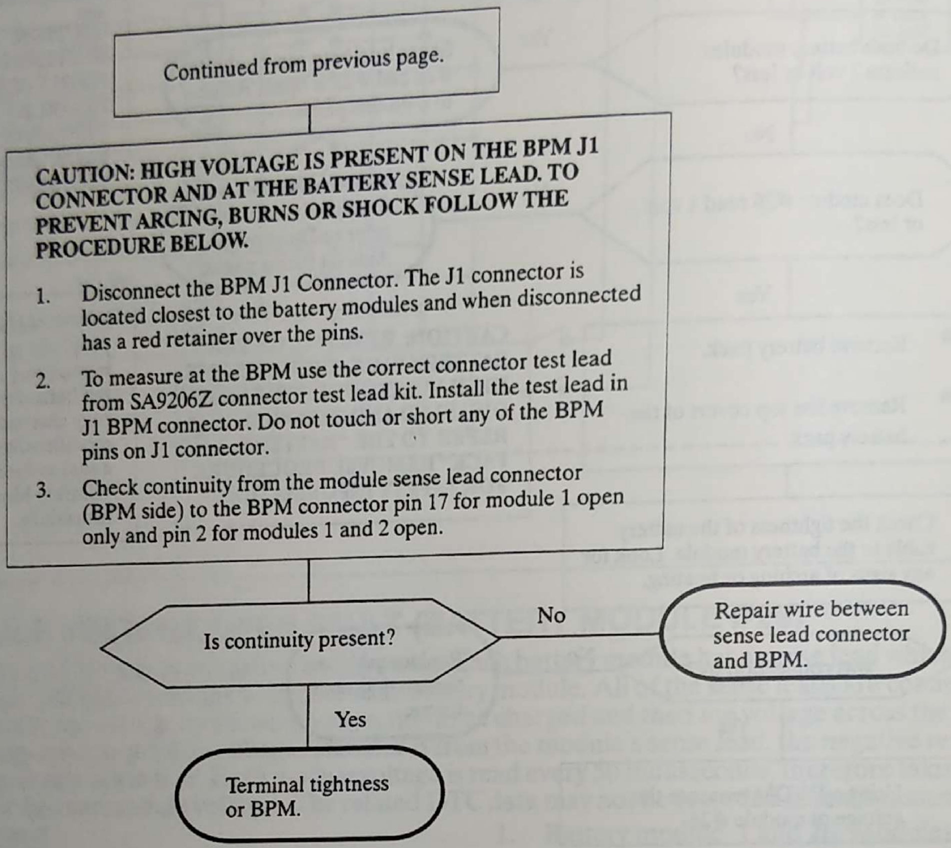
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

)

DTC 201

BATTERY MODULE VOLTAGE OPEN FAULT (BATTERY MODULE #26) – CONTINUED


Continued from previous page.
Is continuity present?
No
Repair wire between sense lead connector and BPM.
Yes
Terminal tightness or BPM.

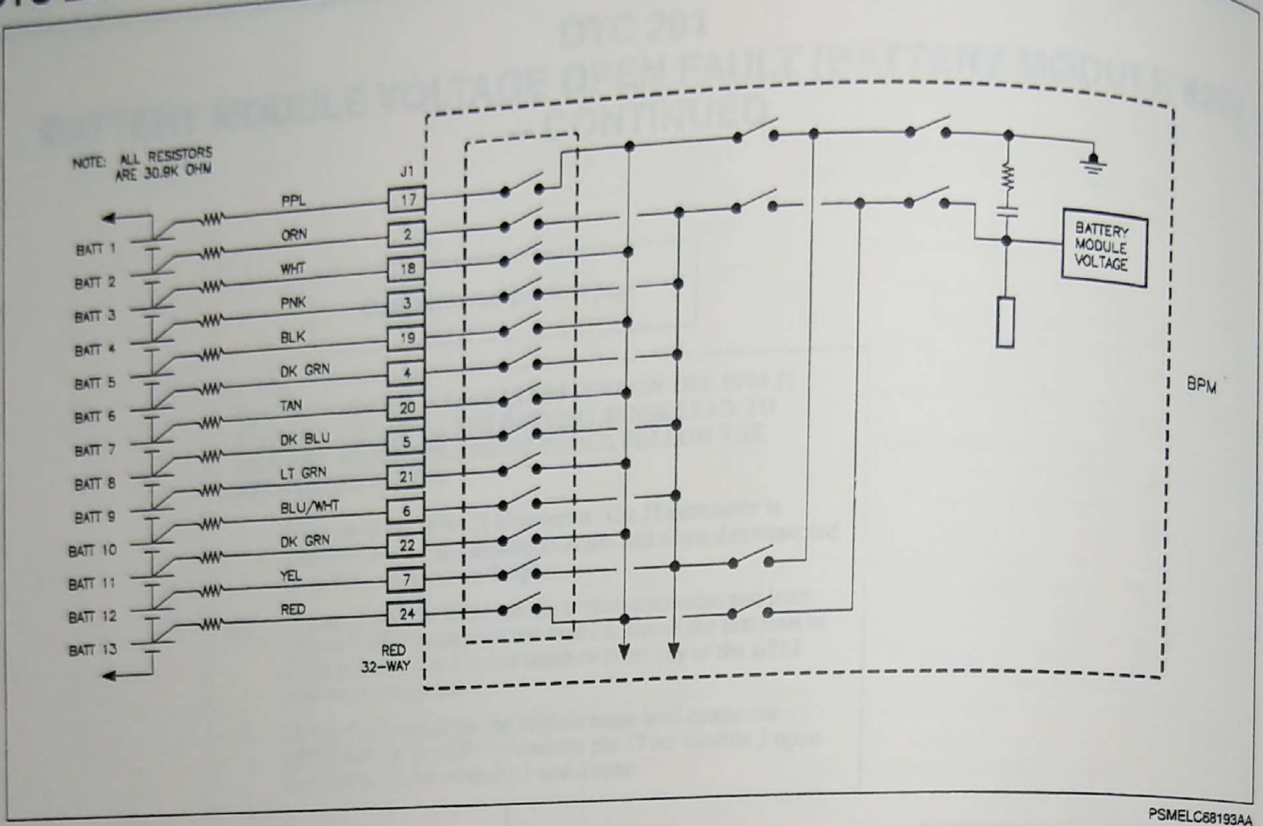
CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW.

1. Disconnect the BPM J1 Connector. The J1 connector is located closest to the battery modules and when disconnected has a red retainer over the pins.
2. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
3. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 17 for module 1 open only and pin 2 for modules 1 and 2 open.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 203 – MARGINAL



PSMELC68193AA

MARGINAL (BATTERY MODULE #26)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of .6 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #26: undervoltage, severe undervoltage out of range.

TELLTALE ILLUMINATED

None

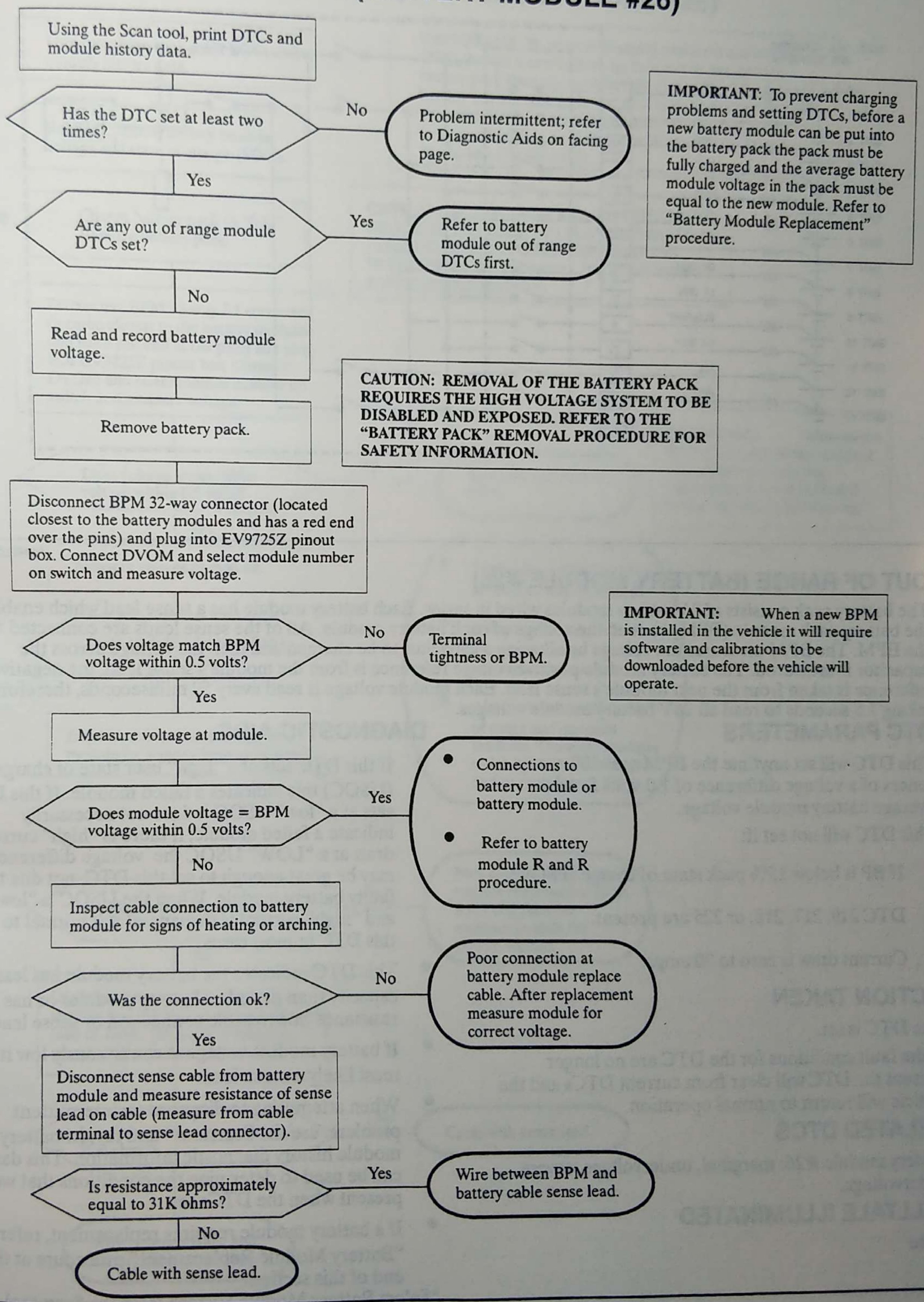
DIAGNOSTIC AIDS

- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.
- If the marginal DTC is set this indicates a battery module with less capacity then the rest of the battery modules or high resistance in the connections.
- If out of range DTCs are set and the out of range battery modules are being replaced. Any marginal battery modules should also be replaced these are battery modules that have a set marginal DTC.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- High resistance at a battery module lead or battery terminal will also cause marginal DTC to set.
- If battery module voltage is continuously low it is most likely a sense lead problem.

*Select Battery Module History from the Scan tool BPM menu.

CS CamScanner

DTC 203
MARGINAL (BATTERY MODULE #26)

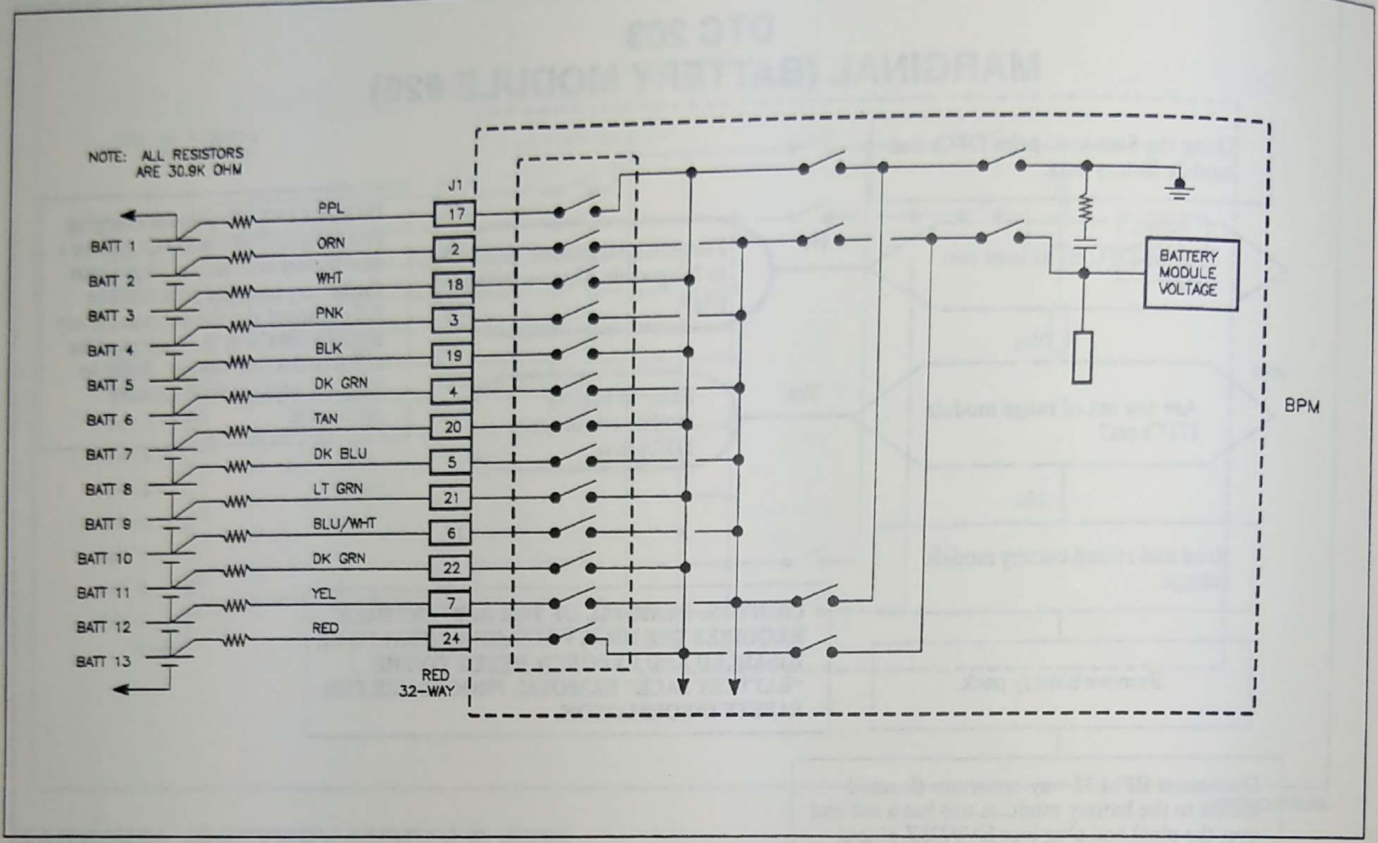

Using the Scan tool, print DTCs and module history data.
Has the DTC set at least two times?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any out of range module DTCs set?
Yes
Refer to battery module out of range DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
Yes
● Connections to battery module or battery module.
● Refer to battery module R and R procedure.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable (measure from cable terminal to sense lead connector).
Is resistance approximately equal to 31K ohms?
Yes
Wire between BPM and battery cable sense lead.
No
Cable with sense lead.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 204 – OUT OF RANGE



PSMELC68193AA

OUT OF RANGE (BATTERY MODULE #26)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the BPM sees 100 occurrences of a voltage difference of 1.0 volts from the average battery module voltage.

This DTC will not set if:

- If BP is below 15% pack state of charge (PSOC).
- DTC 219, 217, 218, or 225 are present.
- Current draw is zero to 20 amps.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Battery module #26: marginal, undervoltage, severe undervoltage.

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

- If this DTC sets at a "high" user state of charge (USOC) this indicates a failed module. If this DTC sets at a "low" USOC it does not necessarily indicate a failed module, if there is "high" current draw at a "LOW" USOC the voltage difference may be great enough to set this DTC, not due to a faulty battery module. When the USOC is "low" and "high" current is demanded it is normal to set this DTC in most cases.
- This DTC indicates the battery module has less capacity than the other battery modules or has high resistance due to cable connection or sense lead.
- If battery module voltage is continuously low it is most likely a sense lead.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review battery module history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If a battery module requires replacement, refer to "Battery Module Replacement" procedure at the end of this section.

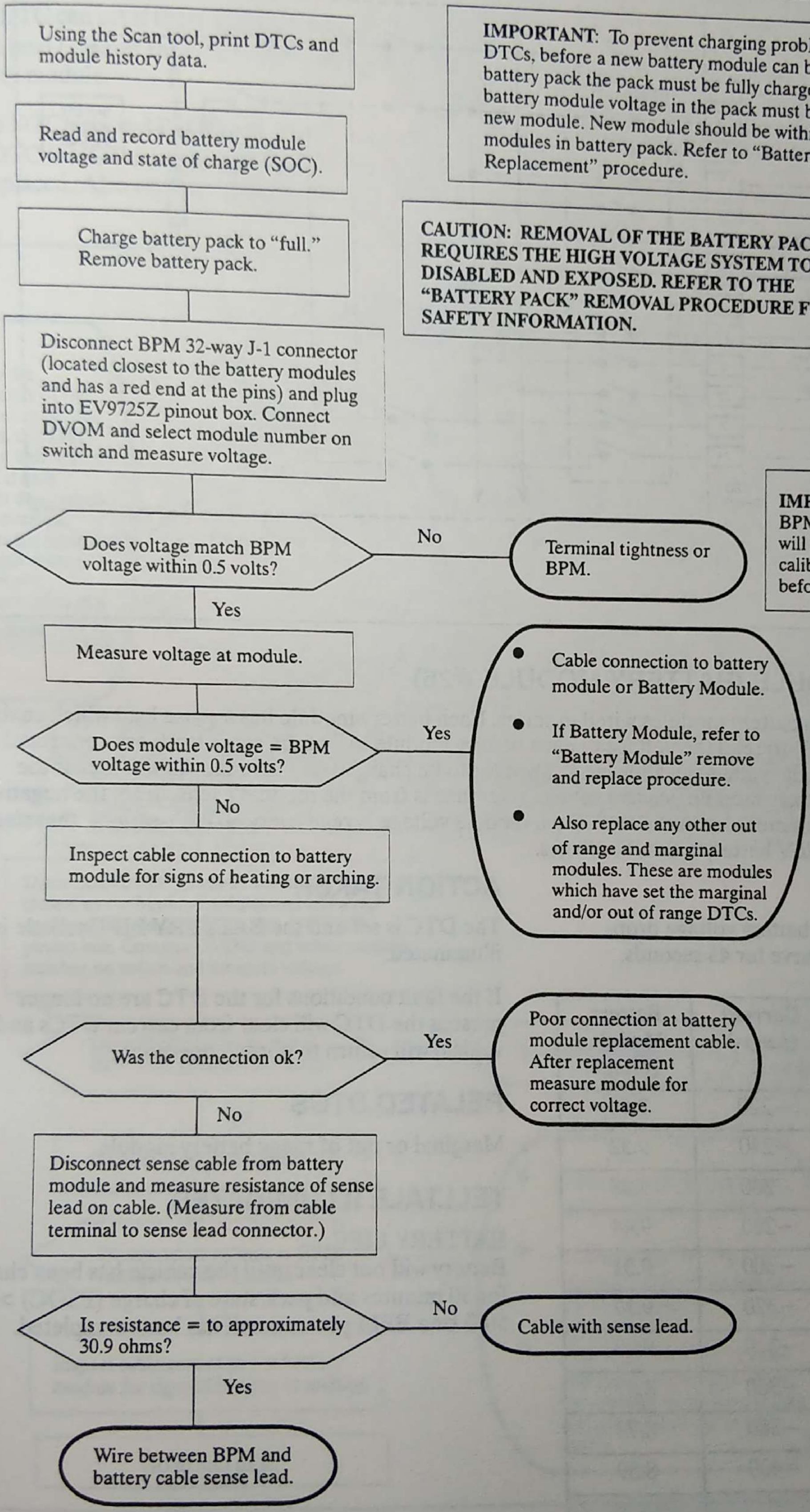
*Select Battery Module History from the Scan tool BPM menu.

DTC 204
OUT OF RANGE (BATTERY MODULE #26)

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. New module should be within 0.5 volts of modules in battery pack. Refer to "Battery Module Replacement" procedure.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.



Using the Scan tool, print DTCs and module history data.

Read and record battery module voltage and state of charge (SOC).

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J-1 connector (located closest to the battery modules and has a red end at the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

- Cable connection to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any other out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

Inspect cable connection to battery module for signs of heating or arching.

Was the connection ok?

Poor connection at battery module replacement cable. After replacement measure module for correct voltage.

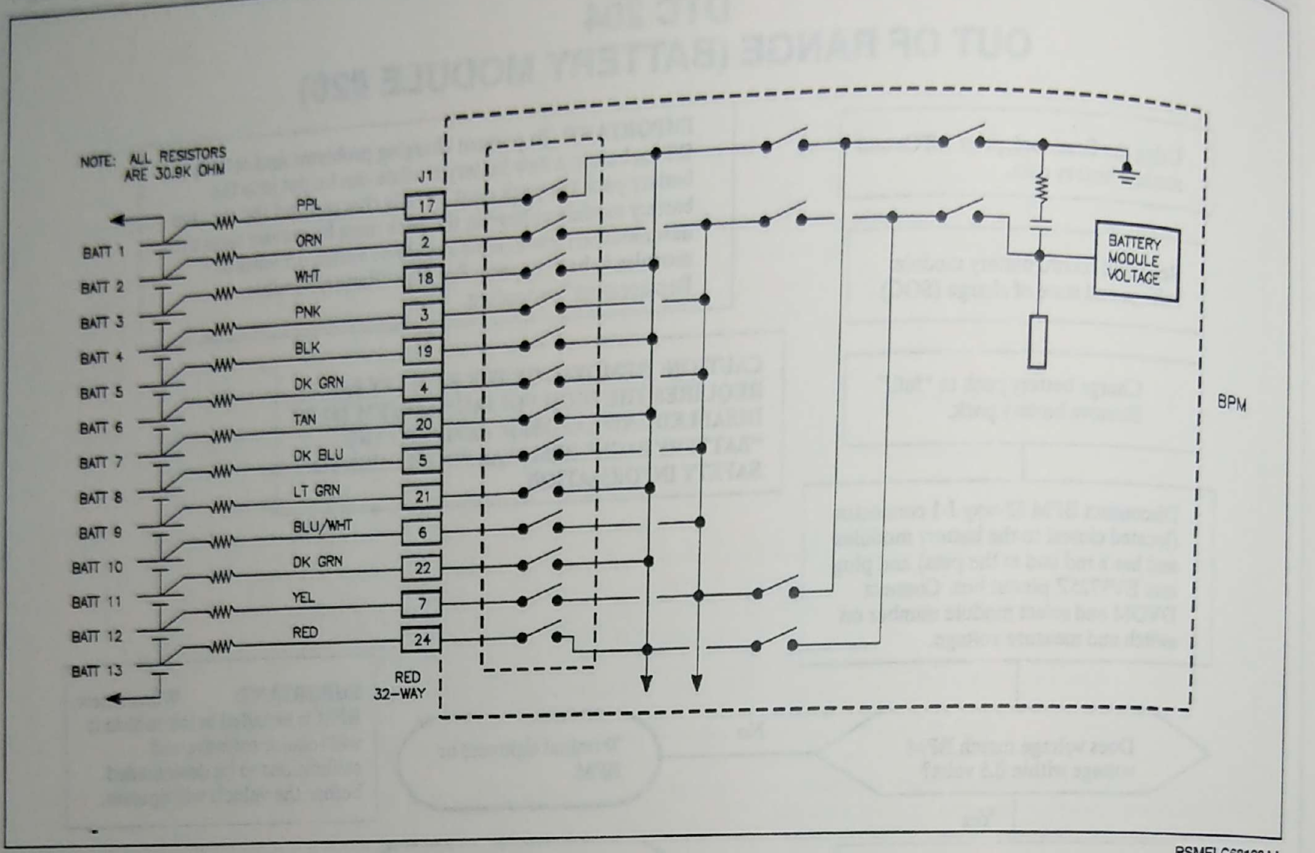
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)

Is resistance = to approximately 30.9 ohms?

Cable with sense lead.

Wire between BPM and battery cable sense lead.

DTC 205 – UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
RED 32–WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

UNDERVOLTAGE MODULE (BATTERY MODULE #26)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current curve for 45 seconds.

Current (Amps)	Battery Module Voltage	Current (Amps)	Battery Module Voltage
0	11.75	−220	9.60
−20	11.10	−240	9.52
−40	10.90	−260	9.48
−60	10.65	−280	9.44
−80	10.45	−300	9.31
−100	10.30	−320	9.17
−120	10.15	−340	9.03
−140	10.00	−360	8.87
−160	9.90	−380	8.73
−180	9.80	−400	8.59
−200	9.70		

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Marginal or out of range battery module.

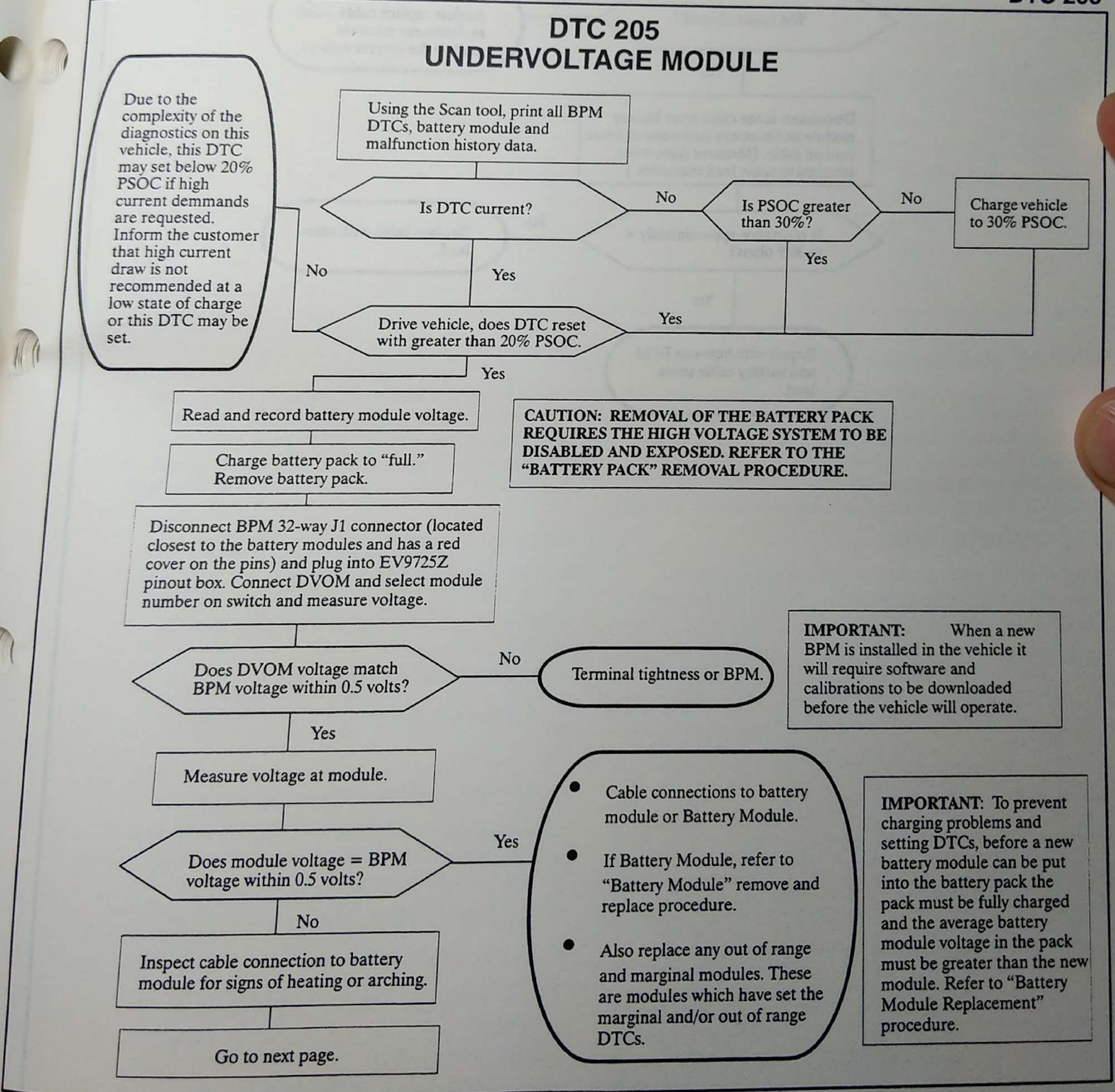
TELLTALE ILLUMINATED

BATTERY LIFE.
Battery will not clear until the vehicle has been charged for 30 minutes and pack state of charge (PSOC) > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can set if vehicle is driven below zero percent user state of charge (USOC) (15% PSOC), especially at high loads. This does not indicate a failure.
- This DTC can set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If the DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also replace any battery modules that have set a marginal or out or range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if any DTCs reset. (PSOC greater than 30%.)
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.



DTC 205
UNDERVOLTAGE MODULE

Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

Using the Scan tool, print all BPM DTCs, battery module and malfunction history data.

Is DTC current?

Is PSOC greater than 30%?

Charge vehicle to 30% PSOC.

Drive vehicle, does DTC reset with greater than 20% PSOC.

Read and record battery module voltage.

Charge battery pack to "full." Remove battery pack.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover on the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

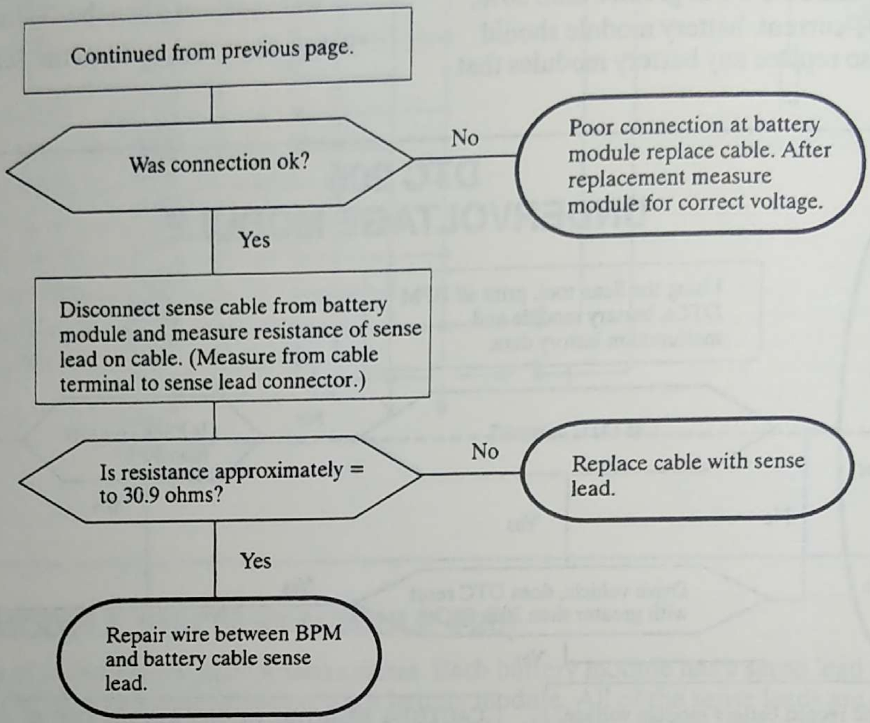
- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

Inspect cable connection to battery module for signs of heating or arching.

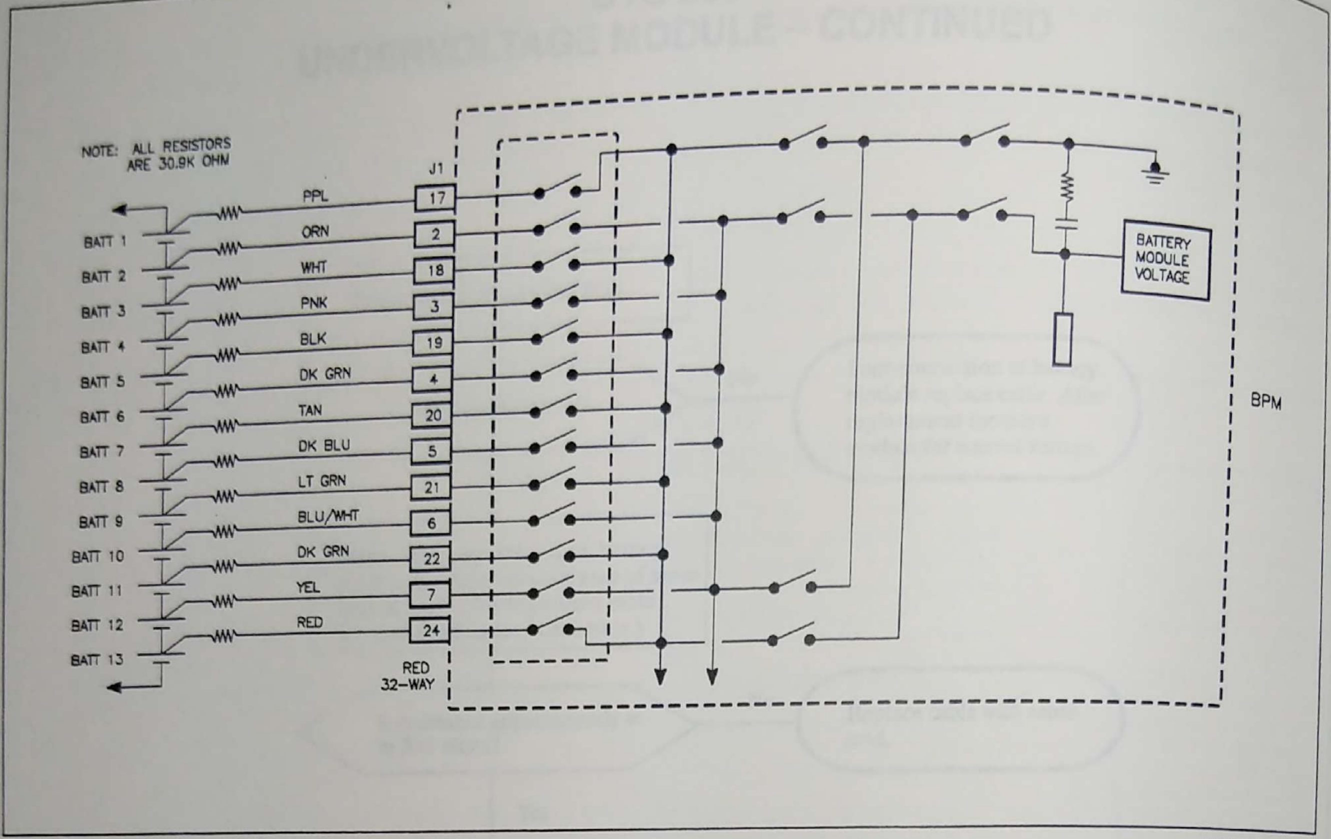
Go to next page.

DTC 205
UNDERVOLTAGE MODULE – CONTINUED


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance of sense lead on cable. (Measure from cable terminal to sense lead connector.)
Is resistance approximately = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 206 – SEVERE UNDERVOLTAGE MODULE


NOTE: ALL RESISTORS ARE 30.9K OHM
J1
PPL
ORN
WHT
PNK
BLK
DK GRN
TAN
DK BLU
LT GRN
BLU/WHT
DK GRN
YEL
RED
17
2
18
3
19
4
20
5
21
6
22
7
24
BATT 1
BATT 2
BATT 3
BATT 4
BATT 5
BATT 6
BATT 7
BATT 8
BATT 9
BATT 10
BATT 11
BATT 12
BATT 13
RED 32-WAY
BATTERY MODULE VOLTAGE
BPM

PSMELC68193AA

SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #26)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table and the condition is present for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle less than 1 mph for 180 seconds.

or

- Vehicle in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 102, BPM 274

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

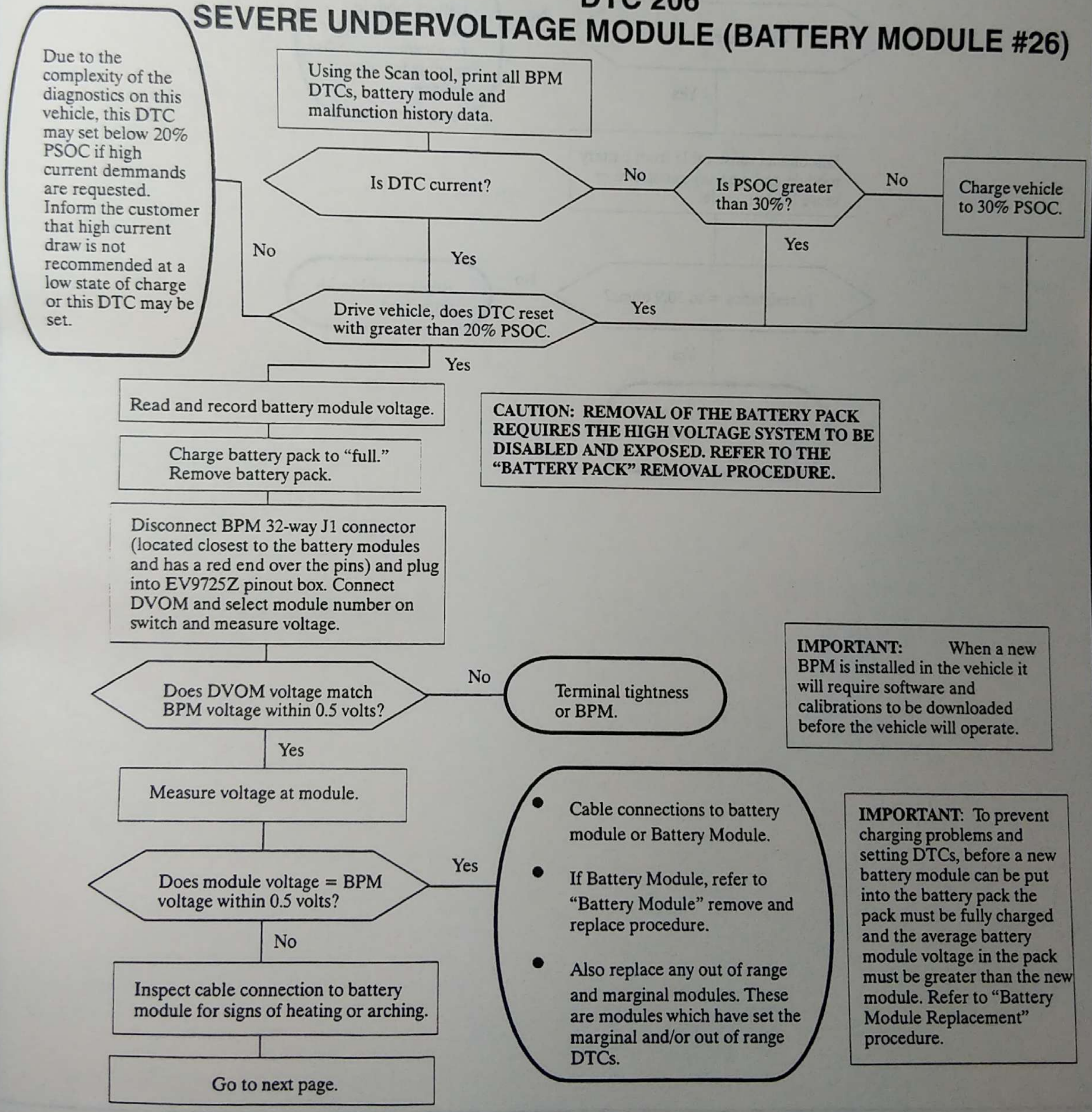
Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC > 50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- This DTC can be set if the vehicle is driven after it reaches zero percent user state of charge (USOC), (15% pack state of charge (PSOC). This does not indicate a failure.
- This DTC can also set if there is high resistance on the sense lead (greater than 30.9 ohms) or a bad battery module.
- If DTC sets and PSOC was greater than 30%, but DTC is NOT current, battery module should be replaced. Also, replace any battery modules that have set a marginal or out of range DTC. Refer to "Battery Module Replacement" procedure at the end of this section.
- Drive vehicle under the same conditions and see if DTC will reset.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 206
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #26)



Due to the complexity of the diagnostics on this vehicle, this DTC may set below 20% PSOC if high current demmands are requested. Inform the customer that high current draw is not recommended at a low state of charge or this DTC may be set.

Using the Scan tool, print all BPM DTCs, battery module and malfunction history data.

Is DTC current?

Is PSOC greater than 30%?

Charge vehicle to 30% PSOC.

Drive vehicle, does DTC reset with greater than 20% PSOC.

Read and record battery module voltage.

Charge battery pack to "full." Remove battery pack.

Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red end over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.

Does DVOM voltage match BPM voltage within 0.5 volts?

Terminal tightness or BPM.

Measure voltage at module.

Does module voltage = BPM voltage within 0.5 volts?

Inspect cable connection to battery module for signs of heating or arching.

Go to next page.

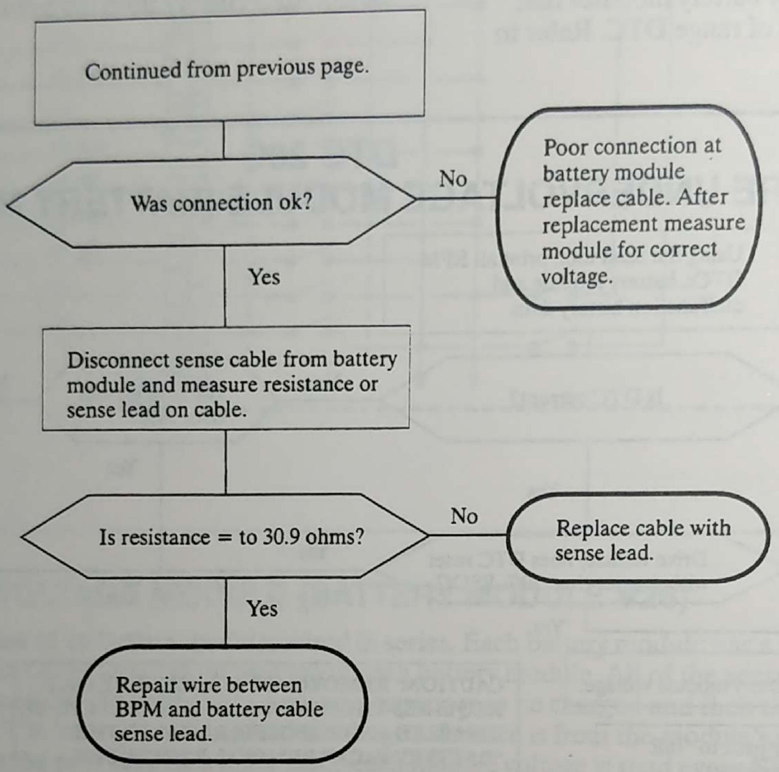
- Cable connections to battery module or Battery Module.
- If Battery Module, refer to "Battery Module" remove and replace procedure.
- Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

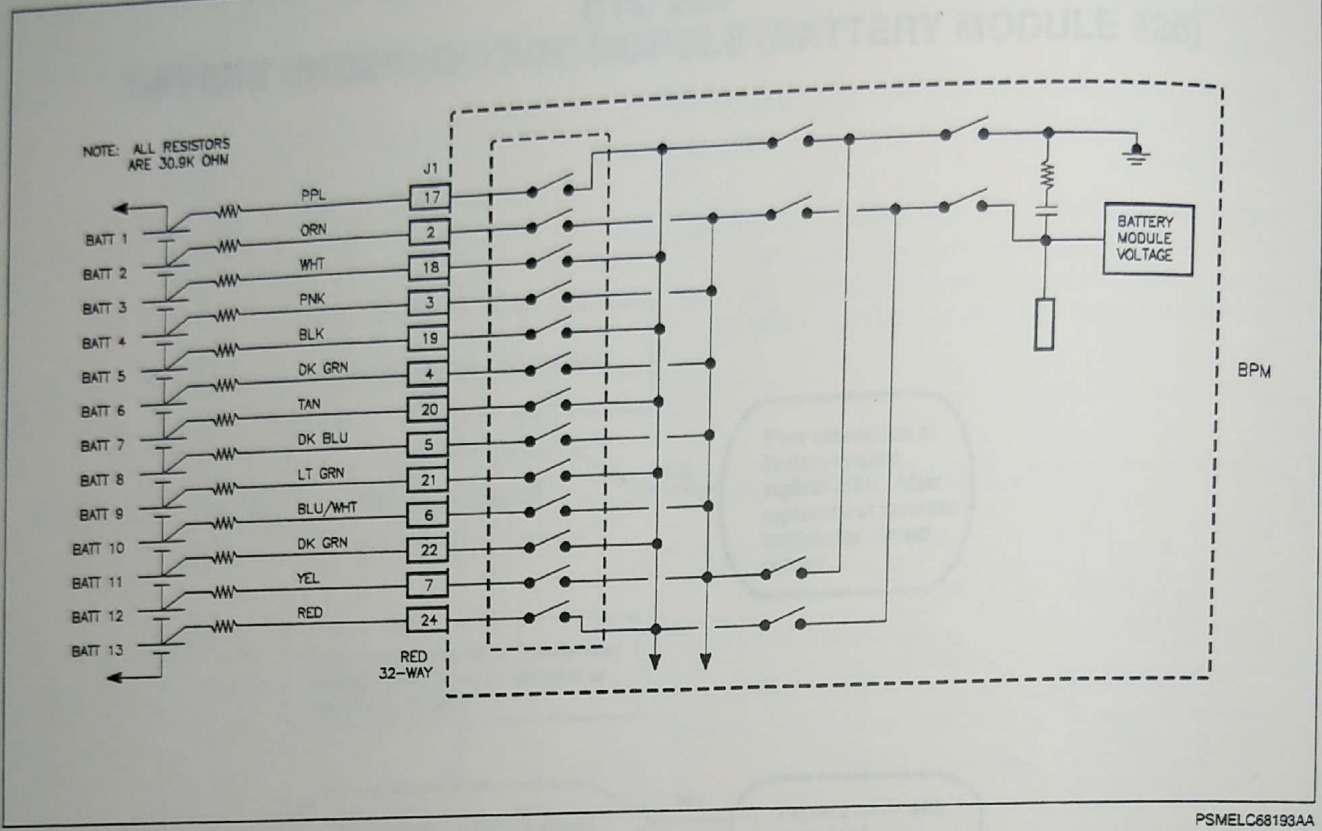
IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be greater than the new module. Refer to "Battery Module Replacement" procedure.

DTC 206
SEVERE UNDERVOLTAGE MODULE (BATTERY MODULE #26)


Continued from previous page.
Was connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Disconnect sense cable from battery module and measure resistance or sense lead on cable.
Is resistance = to 30.9 ohms?
No
Replace cable with sense lead.
Yes
Repair wire between BPM and battery cable sense lead.

NOTES

DTC 207 – SEVERE OVERVOLTAGE MODULE



PSMELC68193AA

SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #26)

The battery pack consists of 26 battery modules wired in series. Each battery module has a sense lead which enables the battery pack module (BPM) to read the voltage of each battery module. All of the sense leads are connected to the BPM. The BPM measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the module's sense lead, the negative reference is taken from the next module's sense lead. Each module voltage is read every 50 milliseconds, therefore taking 1.5 seconds to read all 26V battery module voltages.

DTC PARAMETERS

During propulsion:
This DTC will set anytime the BPM sees a module three volts or higher than the set module voltage for 30 seconds. (Set module voltage is a calculated module voltage based on temperature.)

During no propulsion:
The DTC will set anytime the battery module voltage is 1.5 volts greater than the set module voltage for 30 seconds.

ACTION TAKEN

The DTC is set, the SERVICE NOW and REDUCED PERFORMANCE telltales will be illuminated, and regen will be disabled. If severe over voltage is still detected the BPM will attempt to open auto disconnect. During charging the BPM will command the charger to stop, if the charger fails to stop the auto disconnect will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 274

TELLTALE ILLUMINATED

SERVICE NOW and REDUCED PERFORMANCE

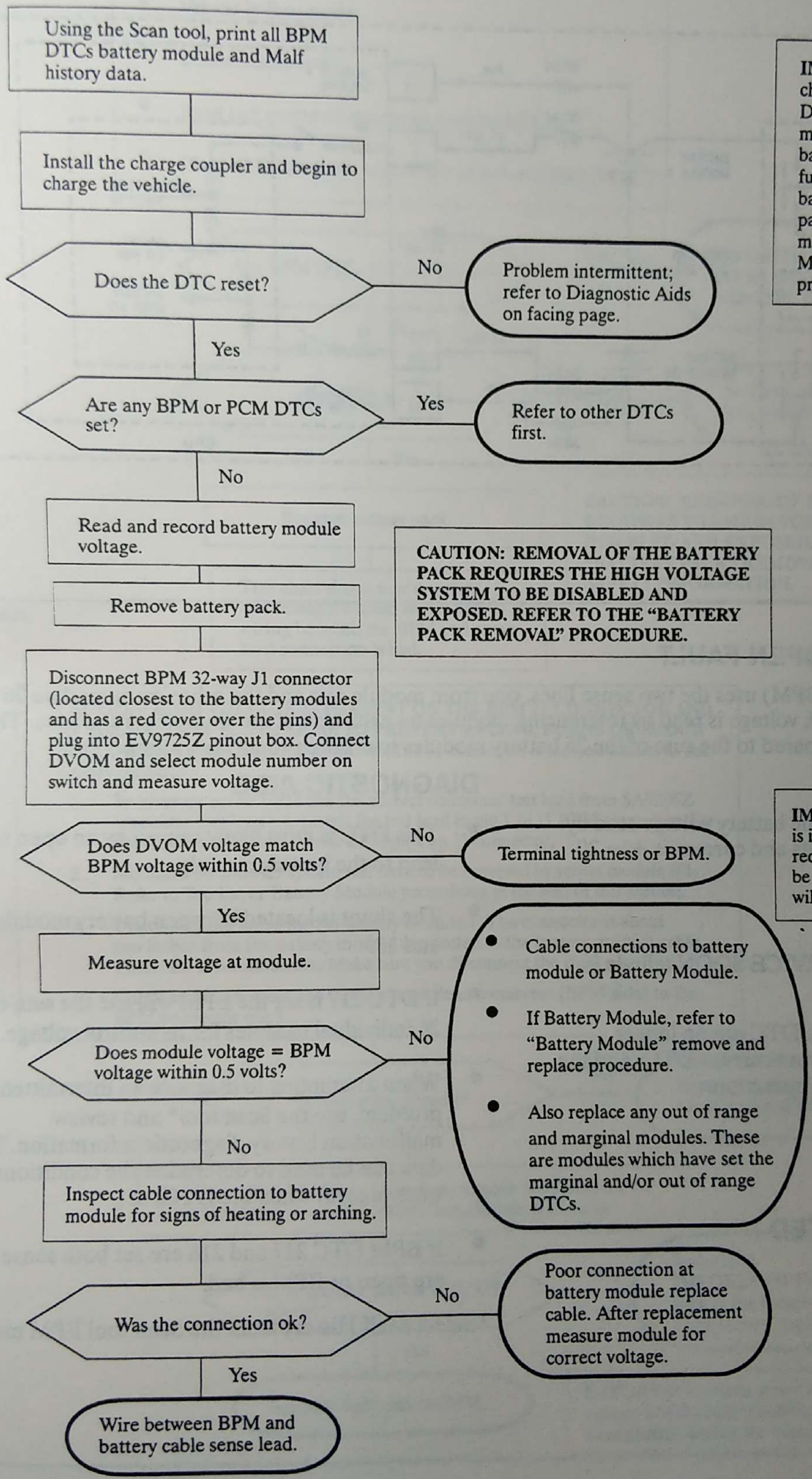
DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This DTC is typically caused by an imbalance in the battery pack after a battery module replacement. Using the Scan tool command leveling let the battery pack charge in leveling to completion. Drive vehicle and verify DTC does not reset.

*Select Malf History from the Scan tool BPM menu.

CS CamScanner

DTC 207
SEVERE OVERVOLTAGE MODULE (BATTERY MODULE #26)

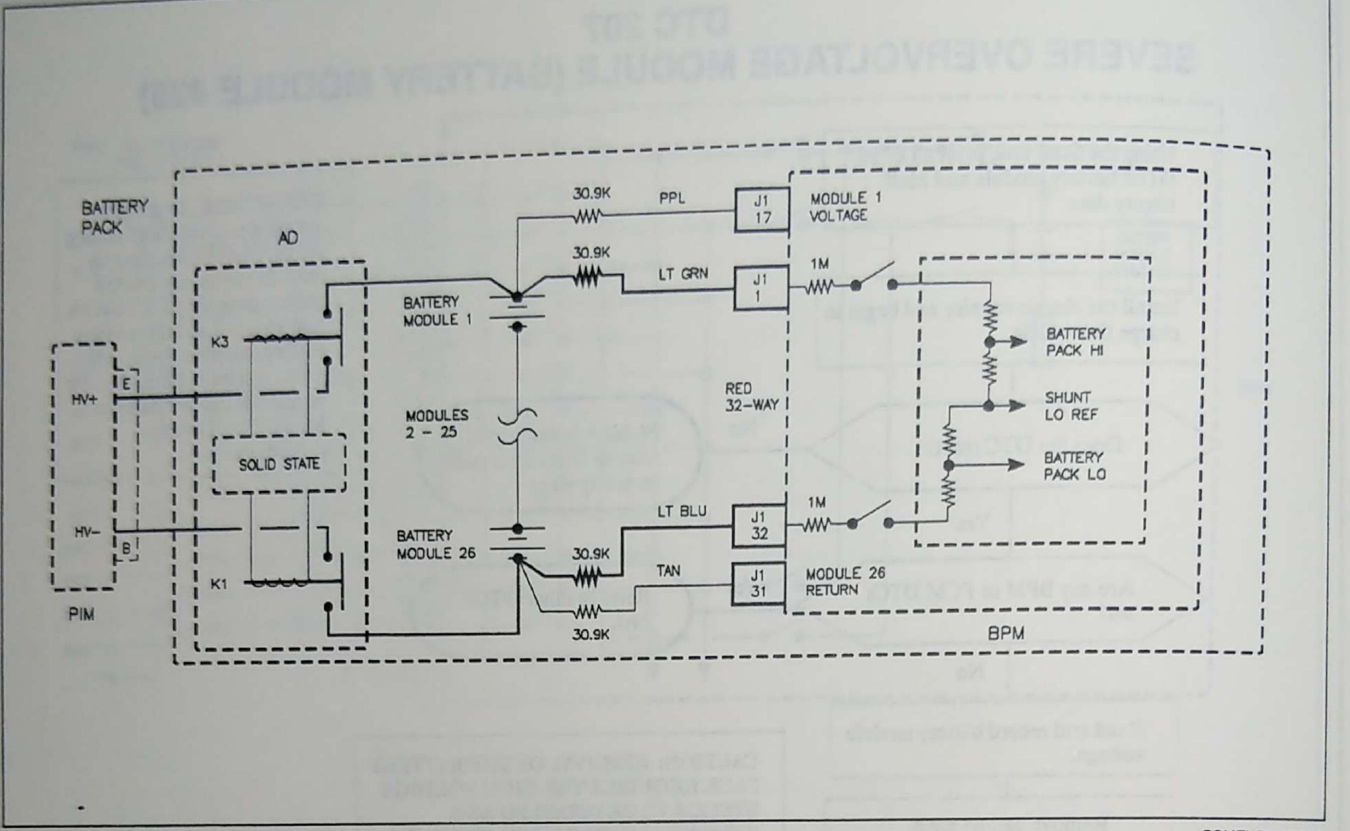

Using the Scan tool, print all BPM DTCs battery module and Malf history data.
Install the charge coupler and begin to charge the vehicle.
Does the DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any BPM or PCM DTCs set?
Yes
Refer to other DTCs first.
No
Read and record battery module voltage.
Remove battery pack.
Disconnect BPM 32-way J1 connector (located closest to the battery modules and has a red cover over the pins) and plug into EV9725Z pinout box. Connect DVOM and select module number on switch and measure voltage.
Does DVOM voltage match BPM voltage within 0.5 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at module.
Does module voltage = BPM voltage within 0.5 volts?
No
• Cable connections to battery module or Battery Module.
• If Battery Module, refer to "Battery Module" remove and replace procedure.
• Also replace any out of range and marginal modules. These are modules which have set the marginal and/or out of range DTCs.
No
Inspect cable connection to battery module for signs of heating or arching.
Was the connection ok?
No
Poor connection at battery module replace cable. After replacement measure module for correct voltage.
Yes
Wire between BPM and battery cable sense lead.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK REMOVAL" PROCEDURE.

IMPORTANT: To prevent charging problems and setting DTCs, before a new battery module can be put into the battery pack the pack must be fully charged and the average battery module voltage in the pack must be equal to the new module. Refer to "Battery Module" replacement procedure.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 217 – BATTERY PACK-HI-OPEN FAULT


BATTERY PACK
AD
HV+
HV–
E
B
PIM
K3
K1
SOLID STATE
30.9K
PPL
30.9K
LT GRN
BATTERY MODULE 1
MODULES 2 – 25
BATTERY MODULE 26
30.9K
30.9K
LT BLU
TAN
J1 17
J1 1
J1 32
J1 31
RED 32–WAY
MODULE 1 VOLTAGE
1M
1M
MODULE 26 RETURN
BATTERY PACK HI
SHUNT LO REF
BATTERY PACK LO
BPM

PSMELC68196AA

BATTERY PACK-HI-OPEN FAULT

The battery pack module (BPM) uses the two sense lines, one from module one and the other from module 26 to read pack voltage. This pack voltage is read by referencing modules on each side of the shunt low reference. This battery pack voltage is compared to the sum of the 26 battery modules to ensure proper operation.

DTC PARAMETERS

This DTC will set anytime the battery voltage read by the BPM is less than 208 volts and current is +/− 20 amps.

ACTION TAKEN

The DTC is set and the SERVICE SOON telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 218

TELLTALE ILLUMINATED

SERVICE SOON

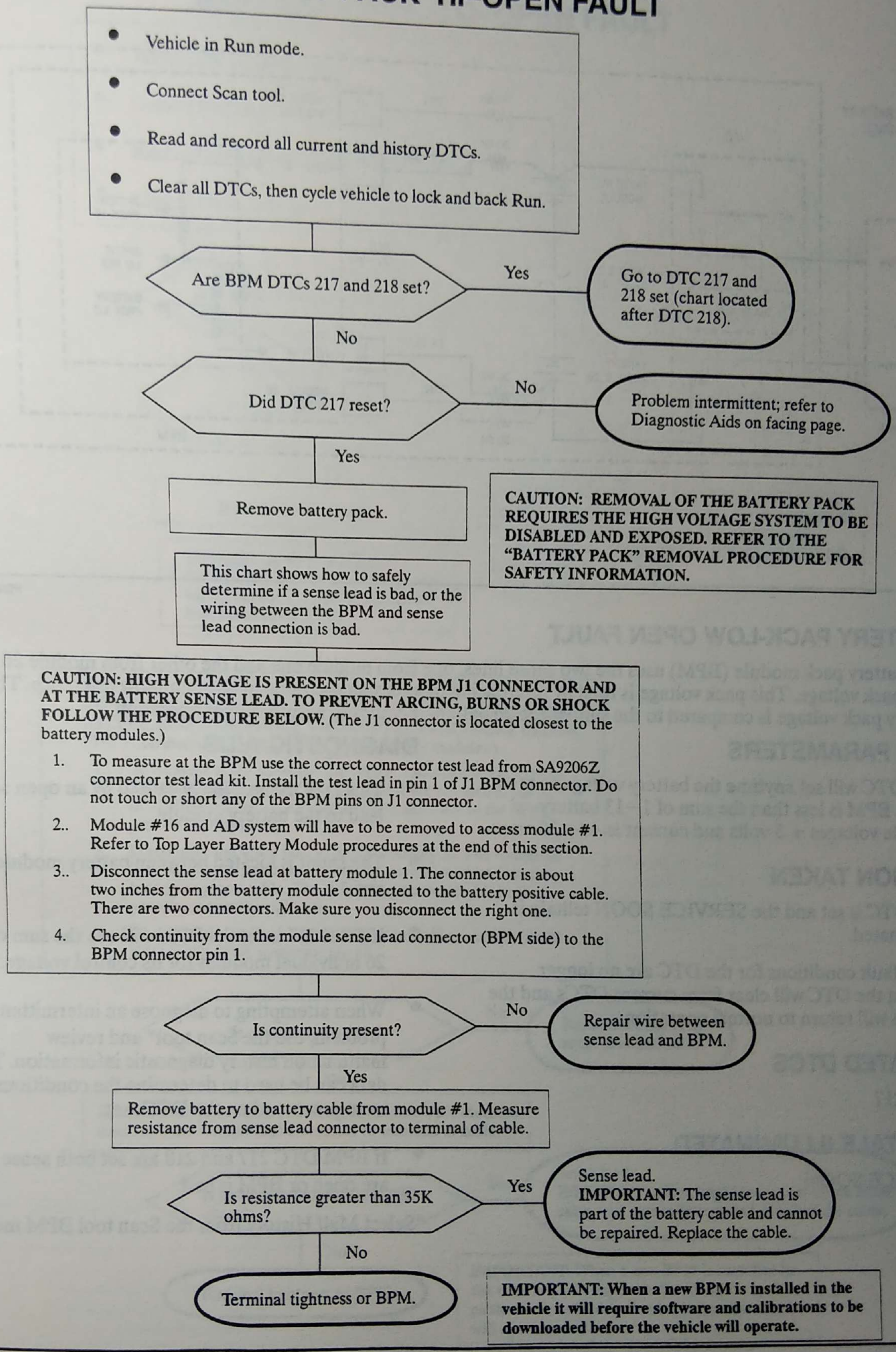
DIAGNOSTIC AIDS

- This DTC is most likely caused by an open sense lead to the battery module.
- The shunt is located between battery modules 12 and 13.
- If DTC 217 is set the BPM will use the sum of the 26 individual modules for its control voltage.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If BPM DTC 217 and 218 are set both sense leads are open or BPM is bad.

*Select Malf History from the Scan tool BPM menu.

CS CamScanner

DTC 217
BATTERY PACK–HI–OPEN FAULT



- Vehicle in Run mode.
- Connect Scan tool.
- Read and record all current and history DTCs.
- Clear all DTCs, then cycle vehicle to lock and back Run.

Are BPM DTCs 217 and 218 set?

Go to DTC 217 and 218 set (chart located after DTC 218).

Did DTC 217 reset?

Problem intermittent; refer to Diagnostic Aids on facing page.

Remove battery pack.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

This chart shows how to safely determine if a sense lead is bad, or the wiring between the BPM and sense lead connection is bad.

CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW. (The J1 connector is located closest to the battery modules.)

1. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in pin 1 of J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
2. Module #16 and AD system will have to be removed to access module #1. Refer to Top Layer Battery Module procedures at the end of this section.
3. Disconnect the sense lead at battery module 1. The connector is about two inches from the battery module connected to the battery positive cable. There are two connectors. Make sure you disconnect the right one.
4. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 1.

Is continuity present?

Repair wire between sense lead and BPM.

Remove battery to battery cable from module #1. Measure resistance from sense lead connector to terminal of cable.

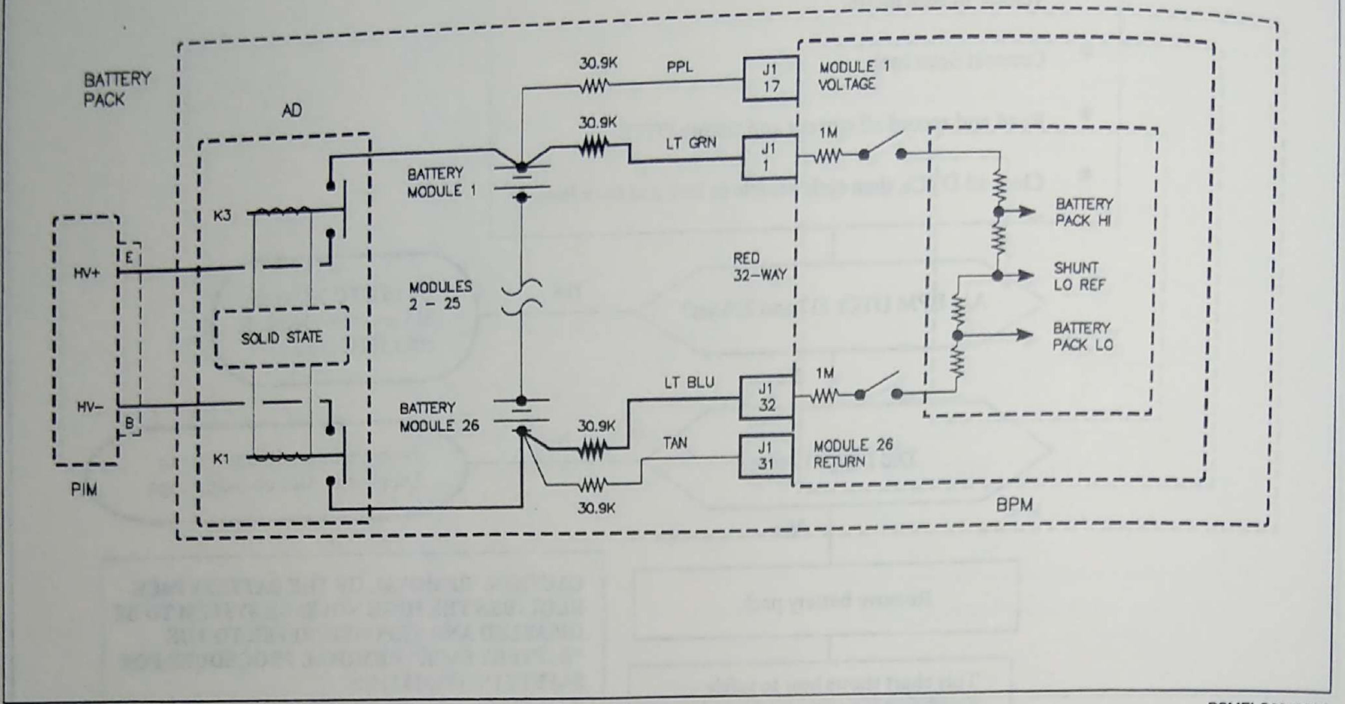
Is resistance greater than 35K ohms?

Sense lead.
IMPORTANT: The sense lead is part of the battery cable and cannot be repaired. Replace the cable.

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 218 – BATTERY PACK-LOW OPEN FAULT


BATTERY PACK
AD
30.9K
PPL
J1 17
MODULE 1 VOLTAGE
30.9K
LT GRN
J1 1
1M
BATTERY MODULE 1
K3
E
HV+
HV–
B
SOLID STATE
MODULES 2 – 25
RED 32–WAY
BATTERY PACK HI
SHUNT LO REF
BATTERY PACK LO
LT BLU
J1 32
1M
BATTERY MODULE 26
30.9K
TAN
J1 31
MODULE 26 RETURN
K1
PIM
30.9K
BPM

PSMELC68196AA

BATTERY PACK-LOW OPEN FAULT

The battery pack module (BPM) uses the two sense lines, one from module one and the other from module 26 to read pack voltage. This pack voltage is read by referencing modules on each side of the shunt low reference. This battery pack voltage is compared to the sum of the 26 battery modules to ensure proper operation.

DTC PARAMETERS

This DTC will set anytime the battery voltage as read by the BPM is less than the sum of 1–13 battery module voltages + 5 volts and current is +/– 20 amps.

ACTION TAKEN

The DTC is set and the SERVICE SOON telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 217

TELLTALE ILLUMINATED

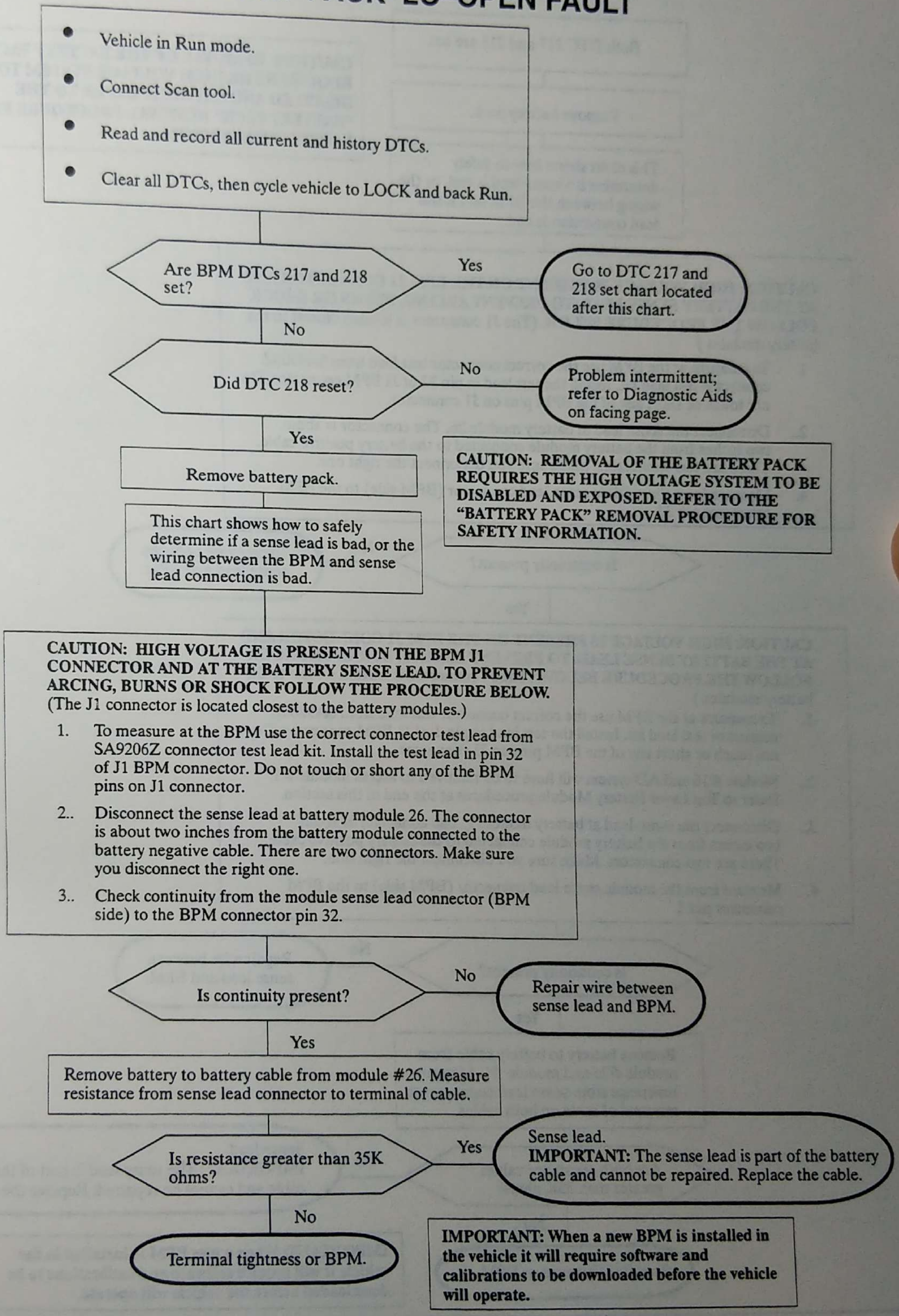
SERVICE SOON

DIAGNOSTIC AIDS

- This DTC is most likely caused by an open sense lead to the battery module.
- The shunt is located between battery modules 12 and 13.
- If DTC 217 is set the BPM will use the sum of the 26 individual modules for its control voltage.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- If BPM DTC 217 and 218 are set both sense leads are open or BPM is bad.

*Select Malf History from the Scan tool BPM menu.

DTC 218
BATTERY PACK–LO–OPEN FAULT



- Vehicle in Run mode.
- Connect Scan tool.
- Read and record all current and history DTCs.
- Clear all DTCs, then cycle vehicle to LOCK and back Run.

Are BPM DTCs 217 and 218 set?

Go to DTC 217 and 218 set chart located after this chart.

Did DTC 218 reset?

Problem intermittent; refer to Diagnostic Aids on facing page.

Remove battery pack.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

This chart shows how to safely determine if a sense lead is bad, or the wiring between the BPM and sense lead connection is bad.

CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW. (The J1 connector is located closest to the battery modules.)

1. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in pin 32 of J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
2.. Disconnect the sense lead at battery module 26. The connector is about two inches from the battery module connected to the battery negative cable. There are two connectors. Make sure you disconnect the right one.
3.. Check continuity from the module sense lead connector (BPM side) to the BPM connector pin 32.

Is continuity present?

Repair wire between sense lead and BPM.

Remove battery to battery cable from module #26. Measure resistance from sense lead connector to terminal of cable.

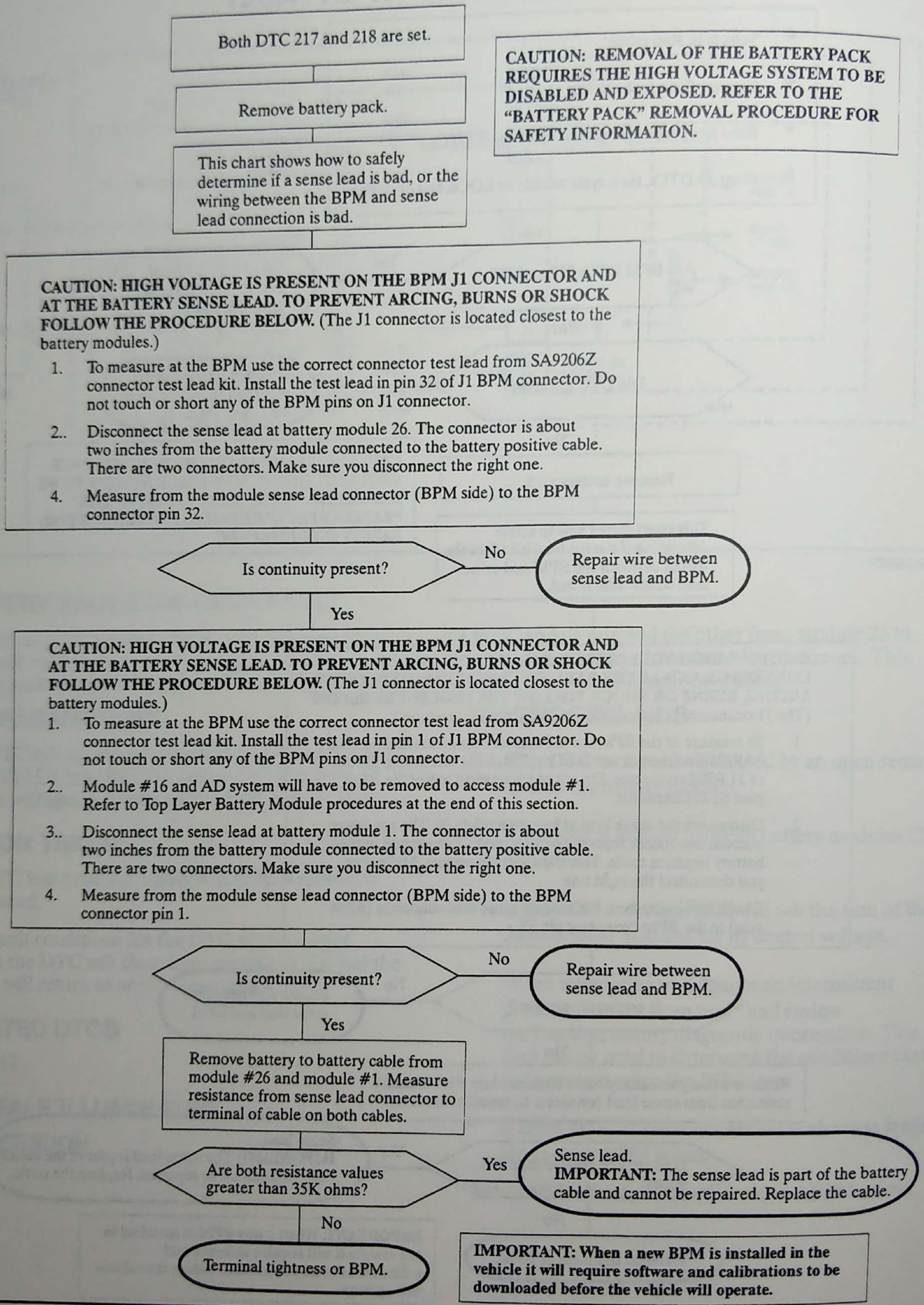
Is resistance greater than 35K ohms?

Sense lead.
IMPORTANT: The sense lead is part of the battery cable and cannot be repaired. Replace the cable.

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 217 AND 218 SET



Both DTC 217 and 218 are set.

Remove battery pack.

This chart shows how to safely determine if a sense lead is bad, or the wiring between the BPM and sense lead connection is bad.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW. (The J1 connector is located closest to the battery modules.)

1. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in pin 32 of J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
2.. Disconnect the sense lead at battery module 26. The connector is about two inches from the battery module connected to the battery positive cable. There are two connectors. Make sure you disconnect the right one.
4. Measure from the module sense lead connector (BPM side) to the BPM connector pin 32.

Is continuity present?

Repair wire between sense lead and BPM.

CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW. (The J1 connector is located closest to the battery modules.)

1. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in pin 1 of J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
2.. Module #16 and AD system will have to be removed to access module #1. Refer to Top Layer Battery Module procedures at the end of this section.
3.. Disconnect the sense lead at battery module 1. The connector is about two inches from the battery module connected to the battery positive cable. There are two connectors. Make sure you disconnect the right one.
4. Measure from the module sense lead connector (BPM side) to the BPM connector pin 1.

Is continuity present?

Repair wire between sense lead and BPM.

Remove battery to battery cable from module #26 and module #1. Measure resistance from sense lead connector to terminal of cable on both cables.

Are both resistance values greater than 35K ohms?

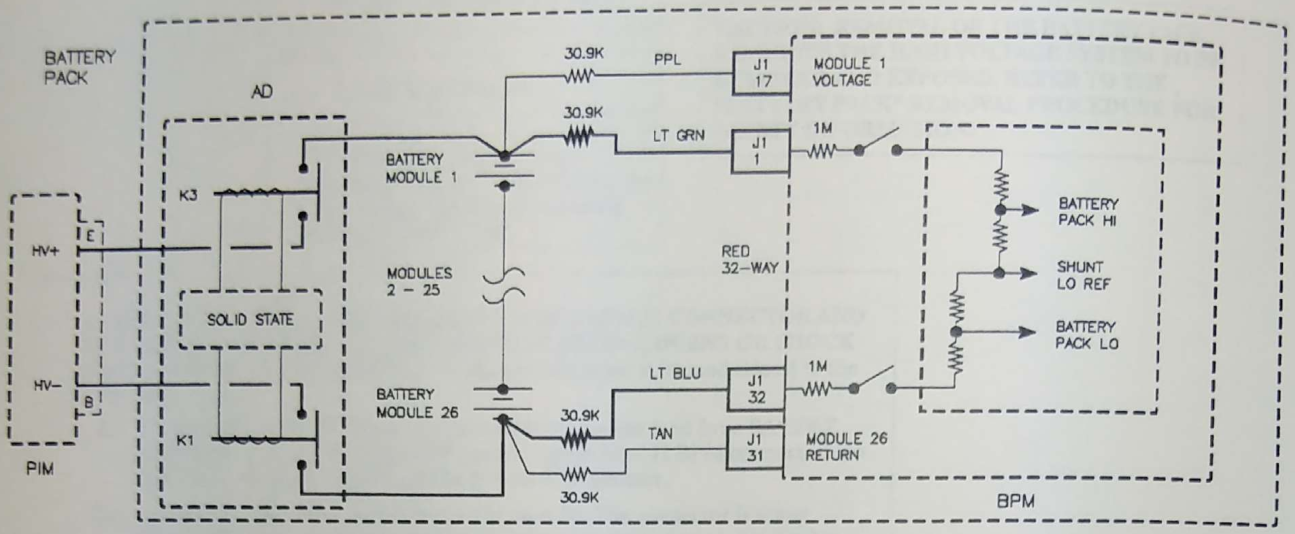
Sense lead.
IMPORTANT: The sense lead is part of the battery cable and cannot be repaired. Replace the cable.

Terminal tightness or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 219 – BATTERY PACK VOLTAGE CORRELATION FAULT


BATTERY PACK
AD
30.9K
PPL
J1 17
MODULE 1 VOLTAGE
30.9K
LT GRN
J1 1
1M
BATTERY MODULE 1
K3
E
HV+
SOLID STATE
MODULES 2 – 25
RED 32–WAY
BATTERY PACK HI
SHUNT LO REF
BATTERY PACK LO
HV–
B
LT BLU
J1 32
1M
BATTERY MODULE 26
30.9K
TAN
J1 31
MODULE 26 RETURN
K1
PIM
30.9K
BPM

PSMELC68196AA

BATTERY PACK VOLTAGE CORRELATION FAULT

The battery pack module (BPM) measures the voltage across all 26 batteries. It takes the value of the lowest individual battery module and multiplies it by 26 and does the same for the highest module value. It compares the measured value pack voltage to the calculated window of the lowest and highest possible pack voltage. If the pack voltage does not fall between the window the DTC will set.

DTC PARAMETERS

This DTC will set anytime the measured battery pack voltage exceeds the window set by the low and highest module.

- 26 X lowest module voltage −3 volts = minimum voltage.
- 26 X highest module voltage + 3 volts = maximum voltage must be present for 45 seconds at +/− 20 amps.
- Conditions must be present for 45 seconds at +/− 20 amps.
- This DTC is only evaluated when BPM DTCs 217 and 218 are not set.

ACTION TAKEN

The DTC is set, the SERVICE SOON telltale will be illuminated, and charging will be disabled.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

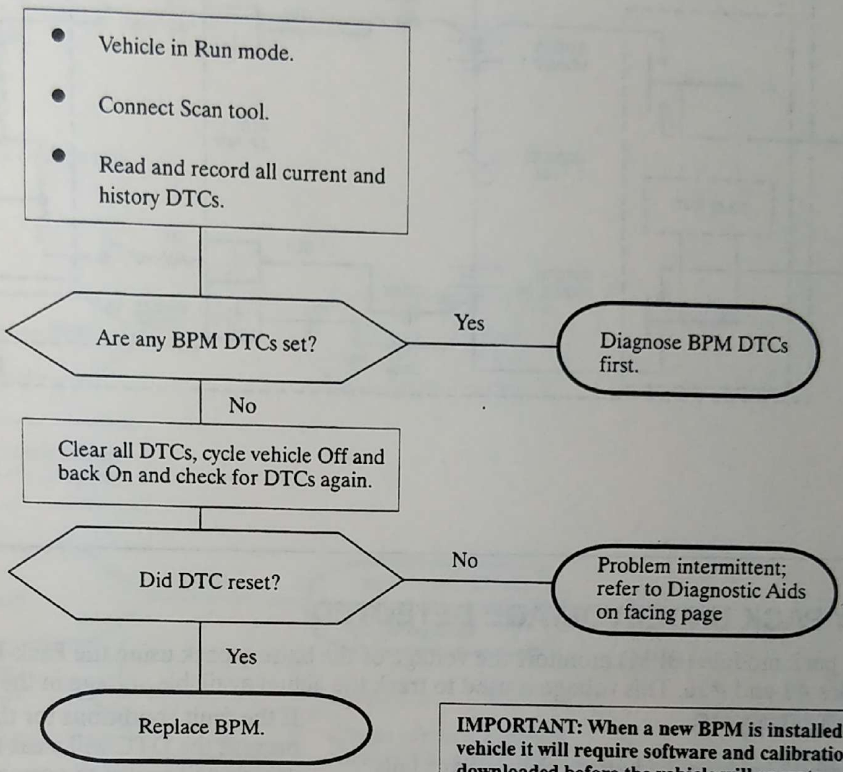
SERVICE SOON

DIAGNOSTIC AIDS

- Mostly likely set when BPM has a current leakage in a component.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

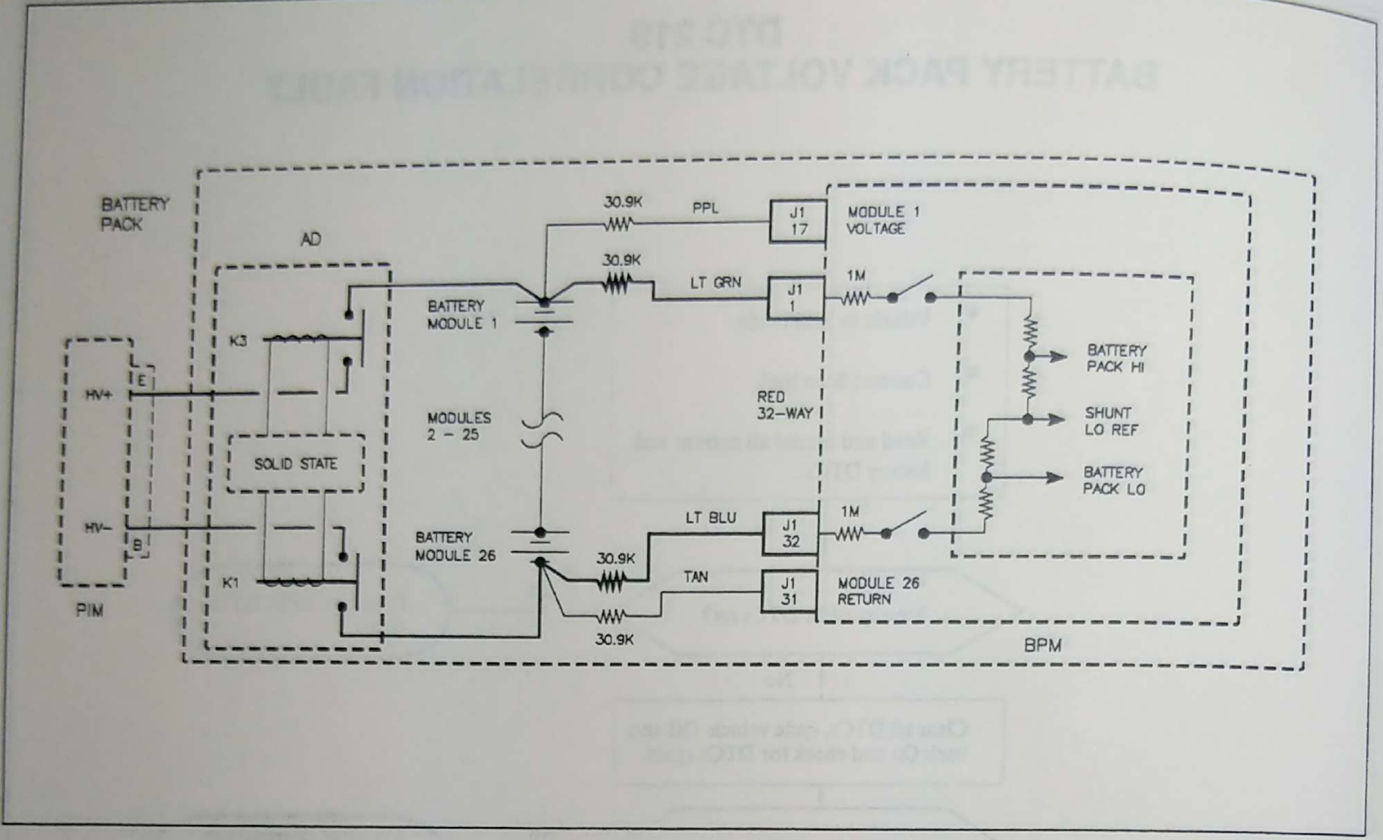
*Select Malf History from the Scan tool BPM menu.

DTC 219
BATTERY PACK VOLTAGE CORRELATION FAULT


Vehicle in Run mode.
Connect Scan tool.
Read and record all current and history DTCs.
Are any BPM DTCs set?
Yes
Diagnose BPM DTCs first.
No
Clear all DTCs, cycle vehicle Off and back On and check for DTCs again.
Did DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page
Yes
Replace BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 220 – BATTERY PACK UNDERVOLTAGE DETECTED


BATTERY PACK
AD
PIM
HV+
HV–
E
B
K3
K1
SOLID STATE
BATTERY MODULE 1
MODULES 2 – 25
BATTERY MODULE 26
30.9K
30.9K
30.9K
30.9K
PPL
LT GRN
LT BLU
TAN
RED 32–WAY
J1 17
J1 1
J1 32
J1 31
MODULE 1 VOLTAGE
MODULE 26 RETURN
1M
1M
BATTERY PACK HI
SHUNT LO REF
BATTERY PACK LO
BPM

PSMELC68196AA

BATTERY PACK UNDERVOLTAGE DETECTED

The battery pack module (BPM) monitors the voltage of the battery pack using the Pack-HI and Pack-LO inputs from modules #1 and #26. This voltage is used to track the actual available voltage in the battery pack.

DTC PARAMETERS

This DTC will set anytime the battery pack voltage falls below the voltage vs. current table for 45 seconds.

Current (Amps)	Battey Pack Voltage
0	305.5
–20	288.6
–40	283.4
–60	276.9
–80	271.7
–100	267.8
–120	263.9
–140	260.0
–160	257.4
–180	254.8
–200	252.2
–220	249.6
–240	247.5
–260	246.5
–280	245.4
–300	244.4
–320	243.4
–340	242.3
–360	241.3
–380	240.2
–400	239.2

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Module undervoltage DTCs.

TELLTALE ILLUMINATED

BATTERY LIFE

Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC>50% or a BPM power down has been completed.

DIAGNOSTIC AIDS

- Module undervoltage DTC(s) should set before battery pack undervoltage is set.
- This DTC can set if the vehicle is driven after it reaches zero percent USOC (15% PSOC). This indicates a normal condition and vehicle should be charged.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

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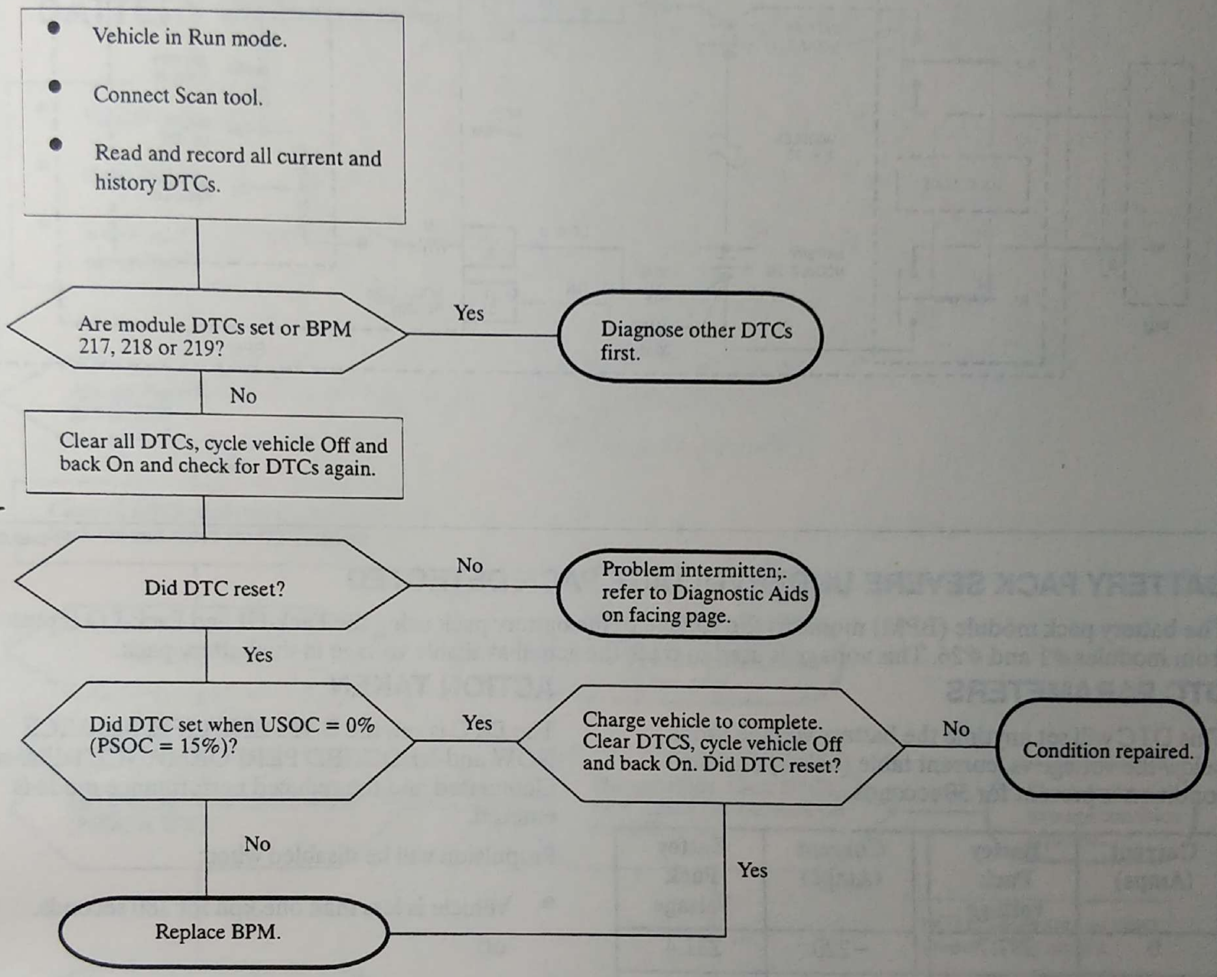
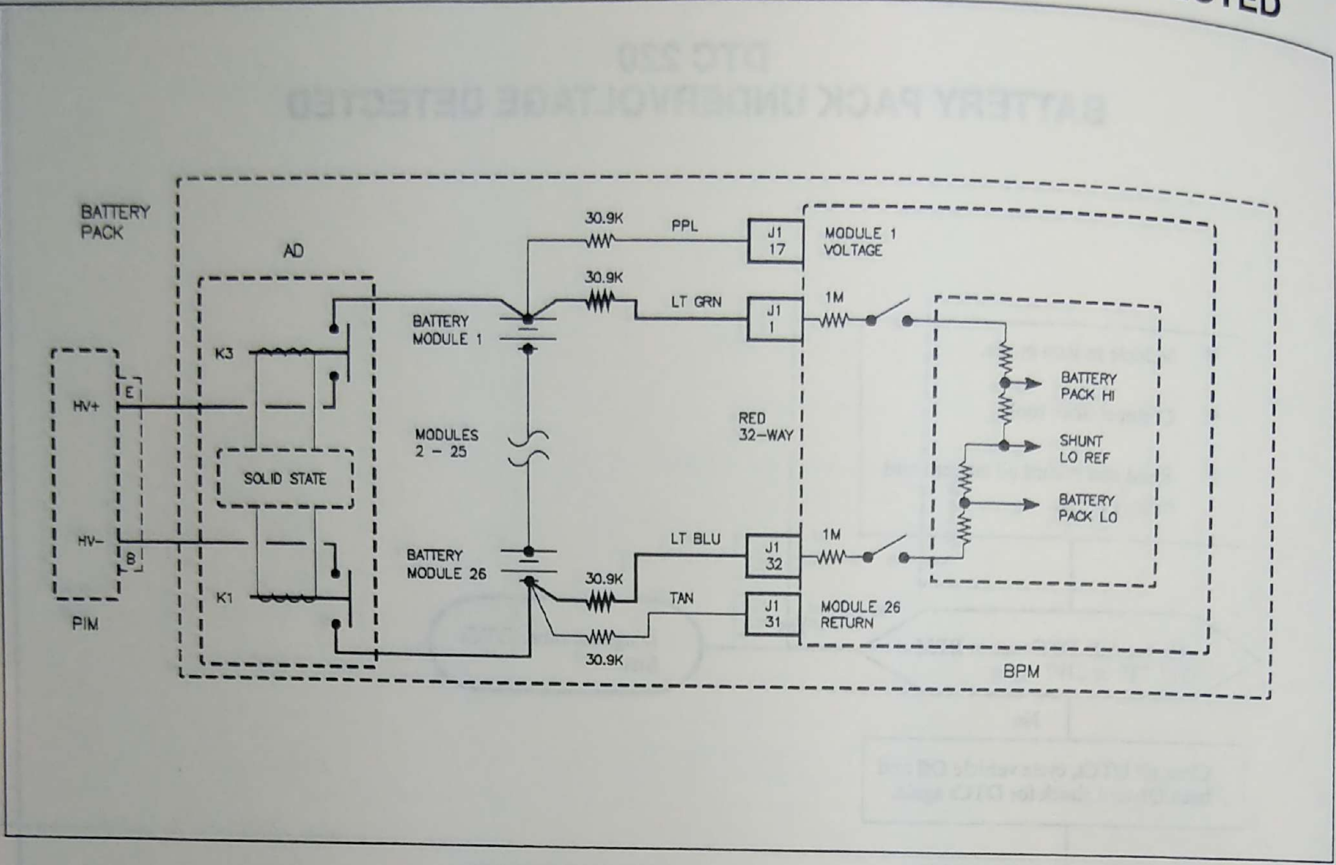
DTC 220
BATTERY PACK UNDERVOLTAGE DETECTED


Vehicle in Run mode.
Connect Scan tool.
Read and record all current and history DTCs.
Are module DTCs set or BPM 217, 218 or 219?
Yes
Diagnose other DTCs first.
No
Clear all DTCs, cycle vehicle Off and back On and check for DTCs again.
Did DTC reset?
No
Problem intermitten;. refer to Diagnostic Aids on facing page.
Yes
Did DTC set when USOC = 0% (PSOC = 15%)?
Yes
Charge vehicle to complete. Clear DTCS, cycle vehicle Off and back On. Did DTC reset?
No
Condition repaired.
Yes
No
Replace BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 221 – BATTERY PACK SEVERE UNDERVOLTAGE PACK DETECTED


BATTERY PACK
AD
30.9K
PPL
J1 17
MODULE 1 VOLTAGE
30.9K
LT GRN
J1 1
1M
BATTERY MODULE 1
K3
E
HV+
BATTERY PACK HI
MODULES 2 – 25
RED 32–WAY
SHUNT LO REF
SOLID STATE
BATTERY PACK LO
HV–
B
LT BLU
J1 32
1M
BATTERY MODULE 26
30.9K
TAN
K1
J1 31
MODULE 26 RETURN
PIM
30.9K
BPM

PSMELC68196AA

BATTERY PACK SEVERE UNDERVOLTAGE PACK DETECTED

The battery pack module (BPM) monitors the voltage of the battery pack using the Pack-HI and Pack-LO inputs from modules #1 and #26. This voltage is used to track the actual available voltage in the battery pack.

DTC PARAMETERS

This DTC will set anytime the battery voltage drops below the voltage vs. current table (below) and the condition is present for 30 seconds.

Current (Amps)	Battey Pack Voltage	Current (Amps)	Battey Pack Voltage
0	297.7	−220	231.4
−20	274.3	−240	229.3
−40	265.2	−260	228.3
−60	258.7	−280	227.2
−80	253.5	−300	226.2
−100	249.6	−320	225.2
−120	245.7	−340	224.1
−140	241.8	−360	223.1
−160	239.2	−380	222.0
−180	236.6	−400	221.0
−200	234.0		

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated and the reduced performance mode is entered.

Propulsion will be disabled when:

- Vehicle is less than one kph for 180 seconds.
  or:
- Vehicle is in park for 10 seconds.
- If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Module DTCs, BPM 220, 217, 218

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC>50% or BPM power down has been completed.

CS CamScanner

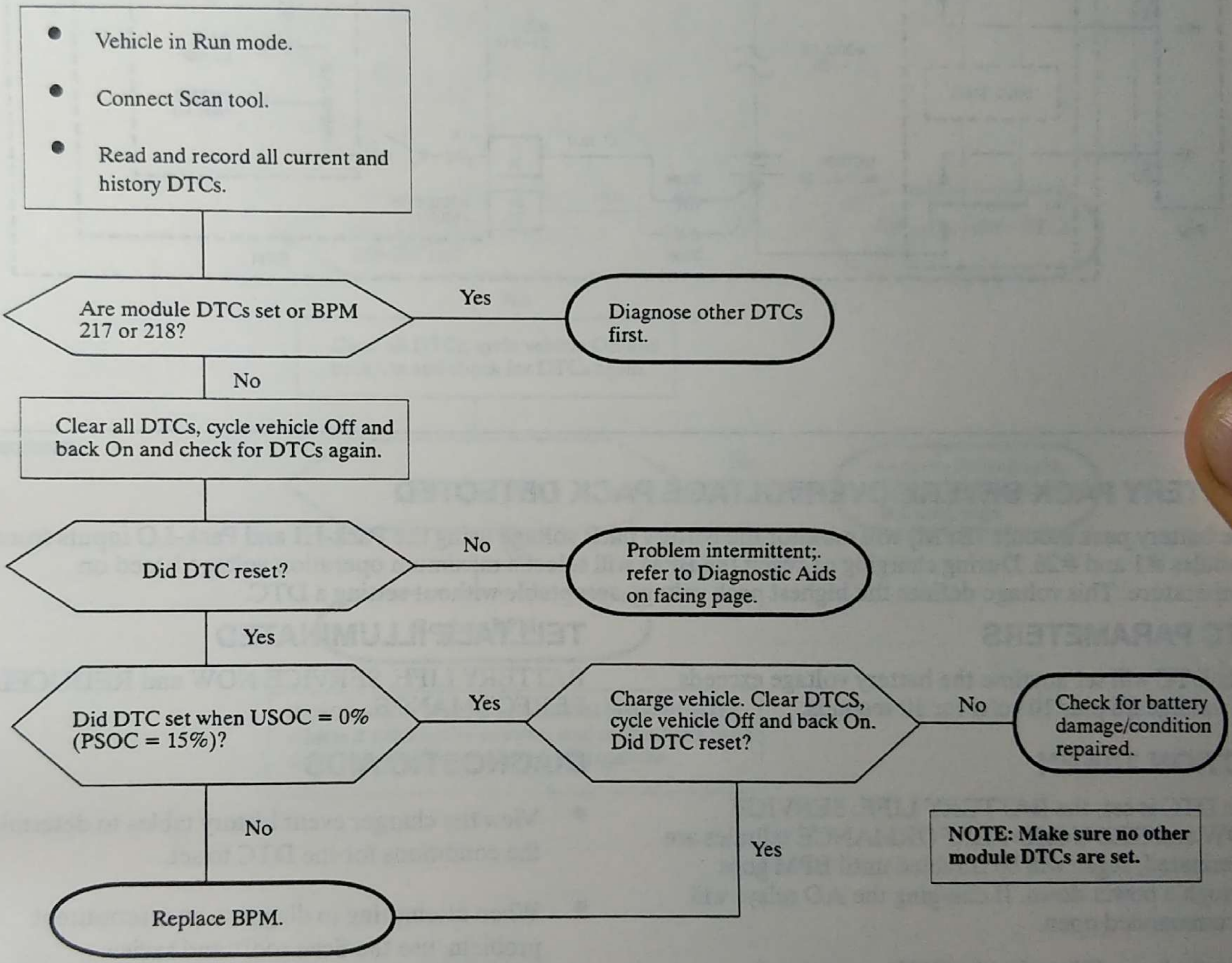
DIAGNOSTIC AIDS

- This DTC will set if the vehicle is driven after it reaches zero percent user state of charge (USOC) (15% PSOC). This indicates a normal condition and vehicle should be charged and driven to evaluate batteries for damage.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 221

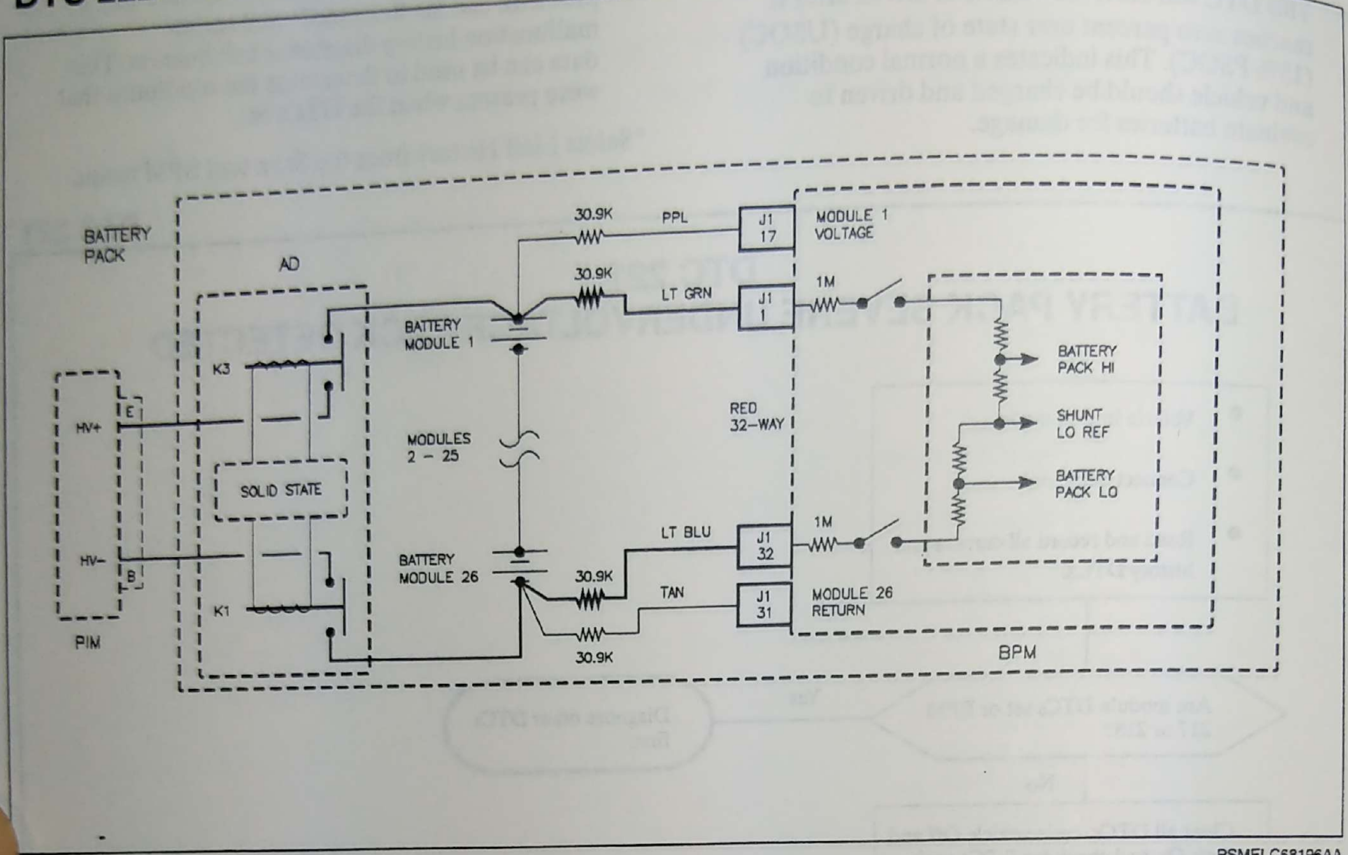
BATTERY PACK SEVERE UNDERVOLTAGE PACK DETECTED


Vehicle in Run mode.
Connect Scan tool.
Read and record all current and history DTCs.
Are module DTCs set or BPM 217 or 218?
Yes
Diagnose other DTCs first.
No
Clear all DTCs, cycle vehicle Off and back On and check for DTCs again.
Did DTC reset?
No
Problem intermittent;. refer to Diagnostic Aids on facing page.
Yes
Did DTC set when USOC = 0% (PSOC = 15%)?
Yes
Charge vehicle. Clear DTCS, cycle vehicle Off and back On. Did DTC reset?
No
Check for battery damage/condition repaired.
Yes
No
Replace BPM.

NOTE: Make sure no other module DTCs are set.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 222 – BATTERY PACK SEVERE OVERVOLTAGE PACK DETECTED


BATTERY PACK
AD
PIM
HV+
HV–
E
B
K3
K1
SOLID STATE
BATTERY MODULE 1
MODULES 2 – 25
BATTERY MODULE 26
30.9K
30.9K
30.9K
30.9K
PPL
LT GRN
LT BLU
TAN
RED 32–WAY
J1 17
J1 1
J1 32
J1 31
MODULE 1 VOLTAGE
MODULE 26 RETURN
1M
1M
BATTERY PACK HI
SHUNT LO REF
BATTERY PACK LO
BPM

PSMELC68196AA

BATTERY PACK SEVERE OVERVOLTAGE PACK DETECTED

The battery pack module (BPM) will monitor the battery pack voltage using the Pack-HI and Pack-LO inputs from modules #1 and #26. During charging or regen the BPM will select a maximum operation voltage based on temperature. This voltage defines the highest pack voltage acceptable without setting a DTC.

DTC PARAMETERS

This DTC will set anytime the battery voltage exceeds the voltage lid plus 10 volts for 10 seconds.

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, regen will be disabled until BPM goes through a power down. If charging the AD relays will be commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Module DTCs.

TELLTALE ILLUMINATED

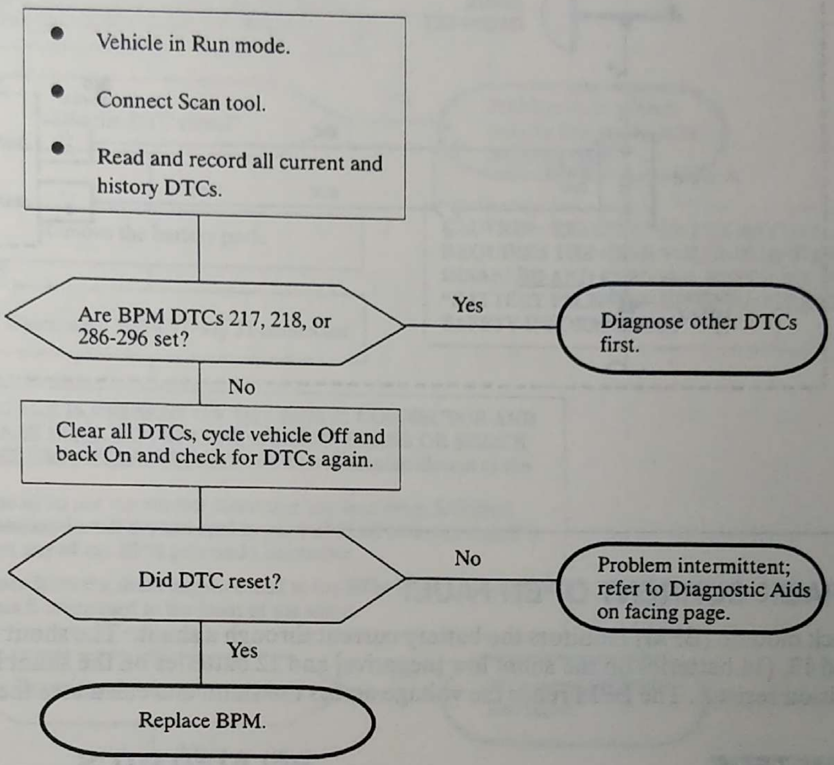
BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.

DIAGNOSTIC AIDS

- View the charger event history tables to determine the conditions for the DTC to set.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

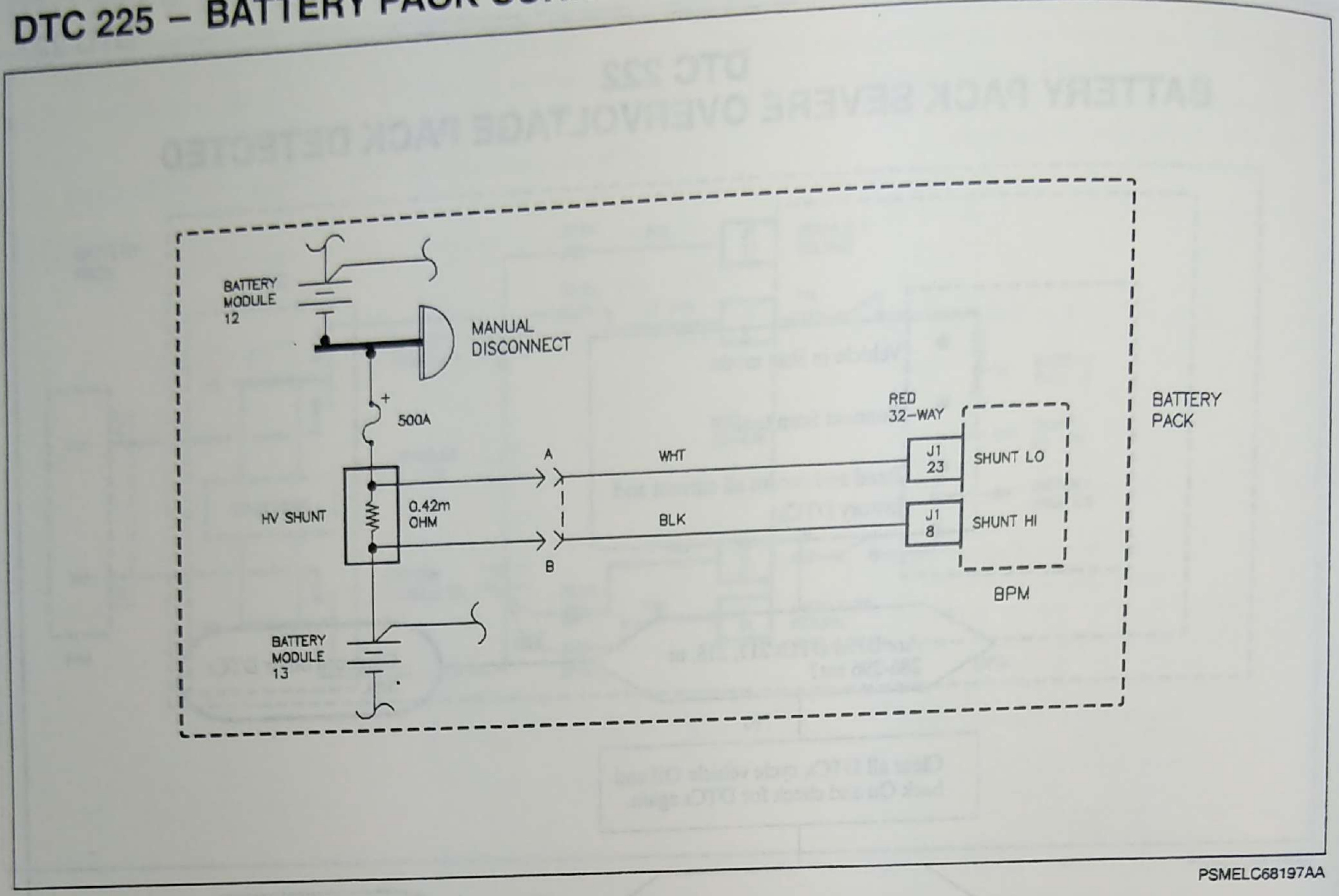
*Select Malf History from the Scan tool BPM menu.

DTC 222
BATTERY PACK SEVERE OVERVOLTAGE PACK DETECTED


Vehicle in Run mode.
Connect Scan tool.
Read and record all current and history DTCs.
Are BPM DTCs 217, 218, or 286-296 set?
Yes
Diagnose other DTCs first.
No
Clear all DTCs, cycle vehicle Off and back On and check for DTCs again.
Did DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Replace BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 225 – BATTERY PACK CURRENT OPEN FAULT



PSMELC68197AA

BATTERY PACK CURRENT OPEN FAULT

The battery pack module (BPM) monitors the battery current through a shunt. The shunt is located between battery modules 12 and 13, (14 batteries on the shunt low [negative] and 12 batteries on the shunt high [positive] side). The shunt is a precision resistor. The BPM reads the voltage across the shunt and calculates the incoming or outgoing current.

DTC PARAMETERS

This DTC will set anytime the current is:

- ± 400 amps for 120 seconds.
- ± 443 amps for 0.5 seconds.

ACTION TAKEN

The DTC is set, the SERVICE SOON telltale is illuminated and charging is disabled.

- Range gauge will increase the range and USOC will flash indicating the BPM cannot accurately calculate.
- Pack current reading will default to zero. Actual pack current can be read on BPM charge info table.
- If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation and after vehicle has been charged to "complete."

RELATED DTCS

None

TELLTALE ILLUMINATED

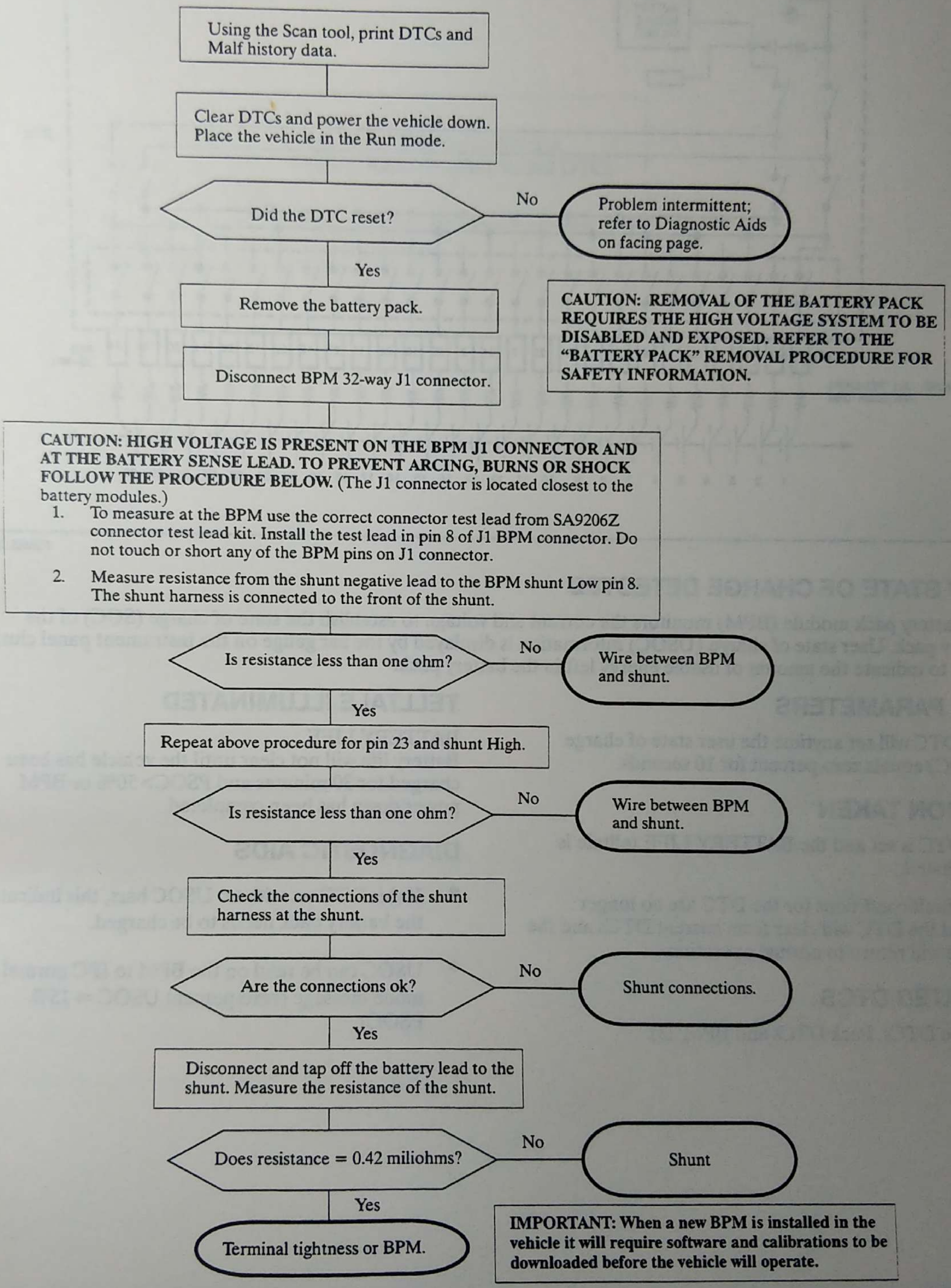
SERVICE SOON and USOC and RANGE will be flashing.

DIAGNOSTIC AIDS

- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.
- This is most likely an open in the shunt HI or shunt LO wiring harness or connections.
- The range gauge miles will increase due to no current seen but vehicle moving.

*Select Malf History from the Scan tool BPM menu.

DTC 225
BATTERY PACK CURRENT OPEN FAULT


Using the Scan tool, print DTCs and Malf history data.
Clear DTCs and power the vehicle down. Place the vehicle in the Run mode.
Did the DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Remove the battery pack.
Disconnect BPM 32-way J1 connector.
Is resistance less than one ohm?
No
Wire between BPM and shunt.
Yes
Repeat above procedure for pin 23 and shunt High.
Is resistance less than one ohm?
No
Wire between BPM and shunt.
Yes
Check the connections of the shunt harness at the shunt.
Are the connections ok?
No
Shunt connections.
Yes
Disconnect and tap off the battery lead to the shunt. Measure the resistance of the shunt.
Does resistance = 0.42 miliohms?
No
Shunt
Yes
Terminal tightness or BPM.

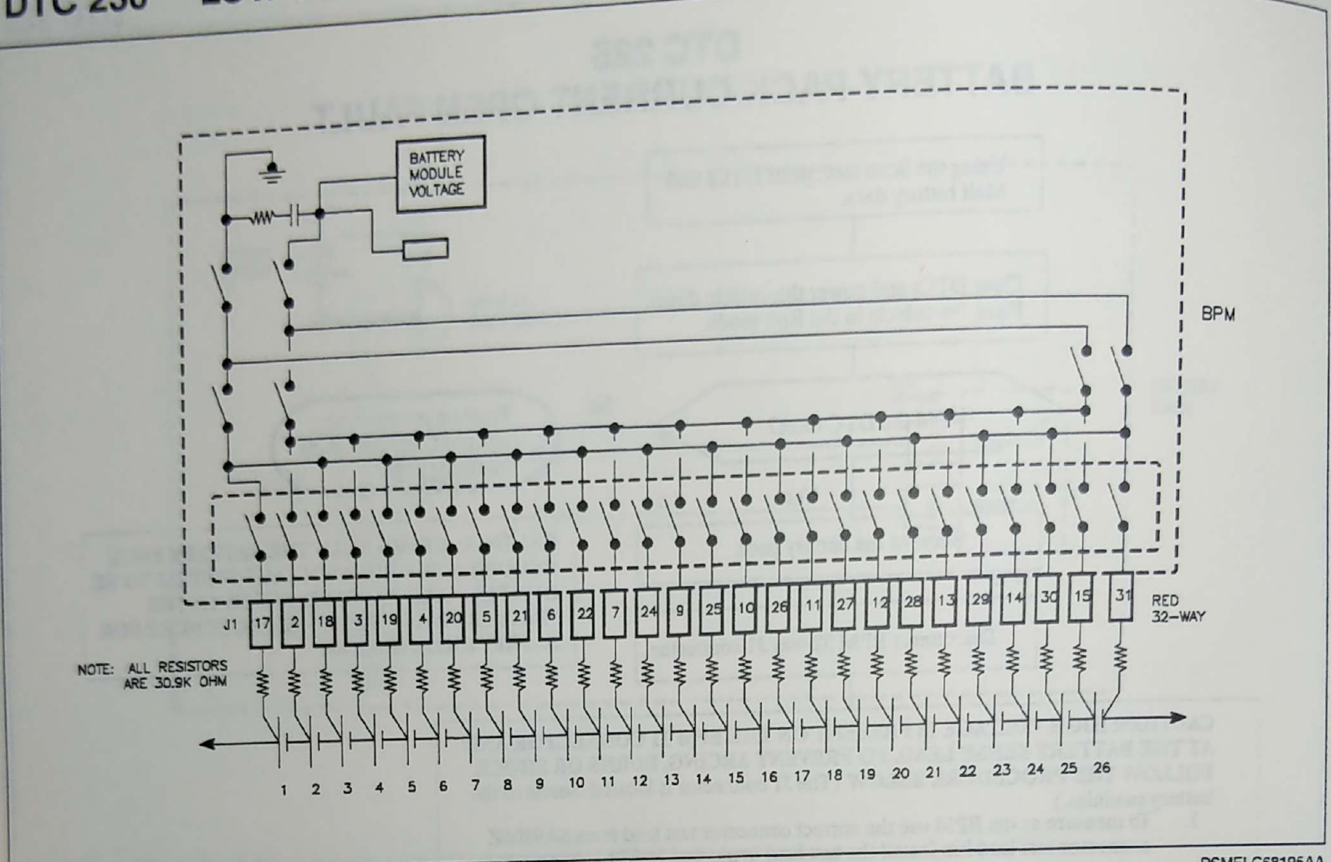
CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

CAUTION: HIGH VOLTAGE IS PRESENT ON THE BPM J1 CONNECTOR AND AT THE BATTERY SENSE LEAD. TO PREVENT ARCING, BURNS OR SHOCK FOLLOW THE PROCEDURE BELOW. (The J1 connector is located closest to the battery modules.)

1. To measure at the BPM use the correct connector test lead from SA9206Z connector test lead kit. Install the test lead in pin 8 of J1 BPM connector. Do not touch or short any of the BPM pins on J1 connector.
2. Measure resistance from the shunt negative lead to the BPM shunt Low pin 8. The shunt harness is connected to the front of the shunt.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 230 – LOW STATE OF CHARGE DETECTED


BATTERY MODULE VOLTAGE
BPM
J1
17 2 18 3 19 4 20 5 21 6 22 7 24 9 25 10 26 11 27 12 28 13 29 14 30 15 31
RED 32–WAY
NOTE: ALL RESISTORS ARE 30.9K OHM
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26

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LOW STATE OF CHARGE DETECTED

The battery pack module (BPM) monitors the current and voltage to establish the state of charge (SOC) of the battery pack. User state of charge (USOC) information is displayed by the bar gauge on the instrument panel cluster (IPC) to indicate the amount of usable energy left in the battery pack.

DTC PARAMETERS

This DTC will set anytime the user state of charge (USOC) equals zero percent for 10 seconds.

ACTION TAKEN

The DTC is set and the BATTERY LIFE telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Module DTCs, Pack DTCs and BPM 231

TELLTALE ILLUMINATED

BATTERY LIFE

Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC>50% or BPM power down has been completed.

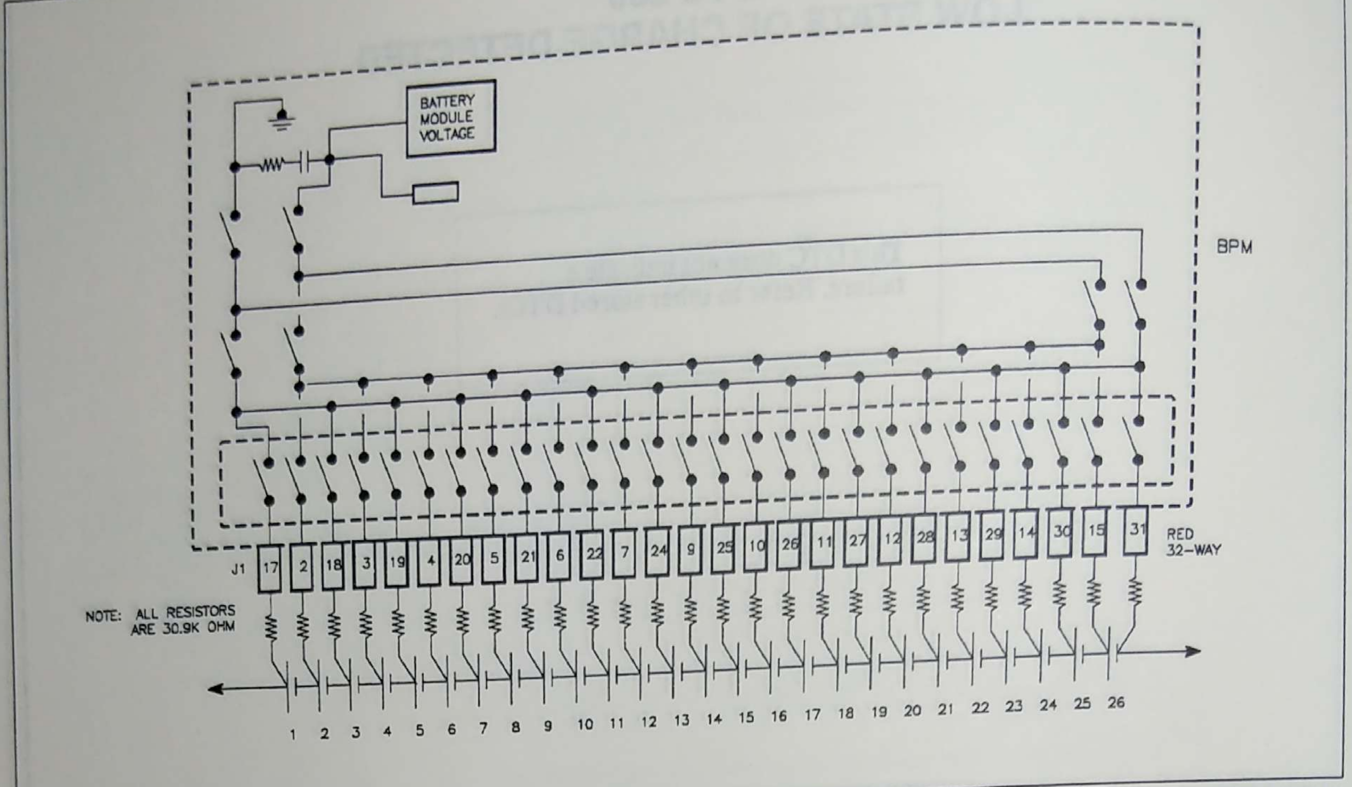
DIAGNOSTIC AIDS

- If this DTC set with no USOC bars, this indicates the battery pack needs to be charged.
- USOC can be read on the BPM to IPC normal mode message (zero percent USOC = 15% PSOC).

DTC 230
LOW STATE OF CHARGE DETECTED

This DTC does not indicate a failure. Refer to other stored DTCs.

DTC 231 – SEVERE LOW STATE OF CHARGE DETECTED


BATTERY MODULE VOLTAGE
BPM
J1
17
2
18
3
19
4
20
5
21
6
22
7
24
9
25
10
26
11
27
12
28
13
29
14
30
15
31
RED 32–WAY
NOTE: ALL RESISTORS ARE 30.9K OHM
1
2
3
4
5
6
7
8
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11
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18
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PSMELC68195AA

SEVERE LOW STATE OF CHARGE DETECTED

The battery pack module (BPM) monitors the current and voltage to establish the state of charge (SOC) of the battery pack. User state of charge (USOC) information is displayed by the bar gauge on the instrument panel cluster (IPC) to indicate the amount of usable energy left in the battery pack.

DTC PARAMETERS

This DTC will set anytime the pack state of charge determined by the BPM is less than 10% for 10 seconds.

ACTION TAKEN

The DTC is set, the BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE telltales are illuminated, and reduced performance mode is entered.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Module DTCs and BPM 230

TELLTALE ILLUMINATED

BATTERY LIFE, SERVICE NOW and REDUCED PERFORMANCE.
Battery life will not clear until the vehicle has been charged for 30 minutes and PSOC>50% or BPM power down has been completed.

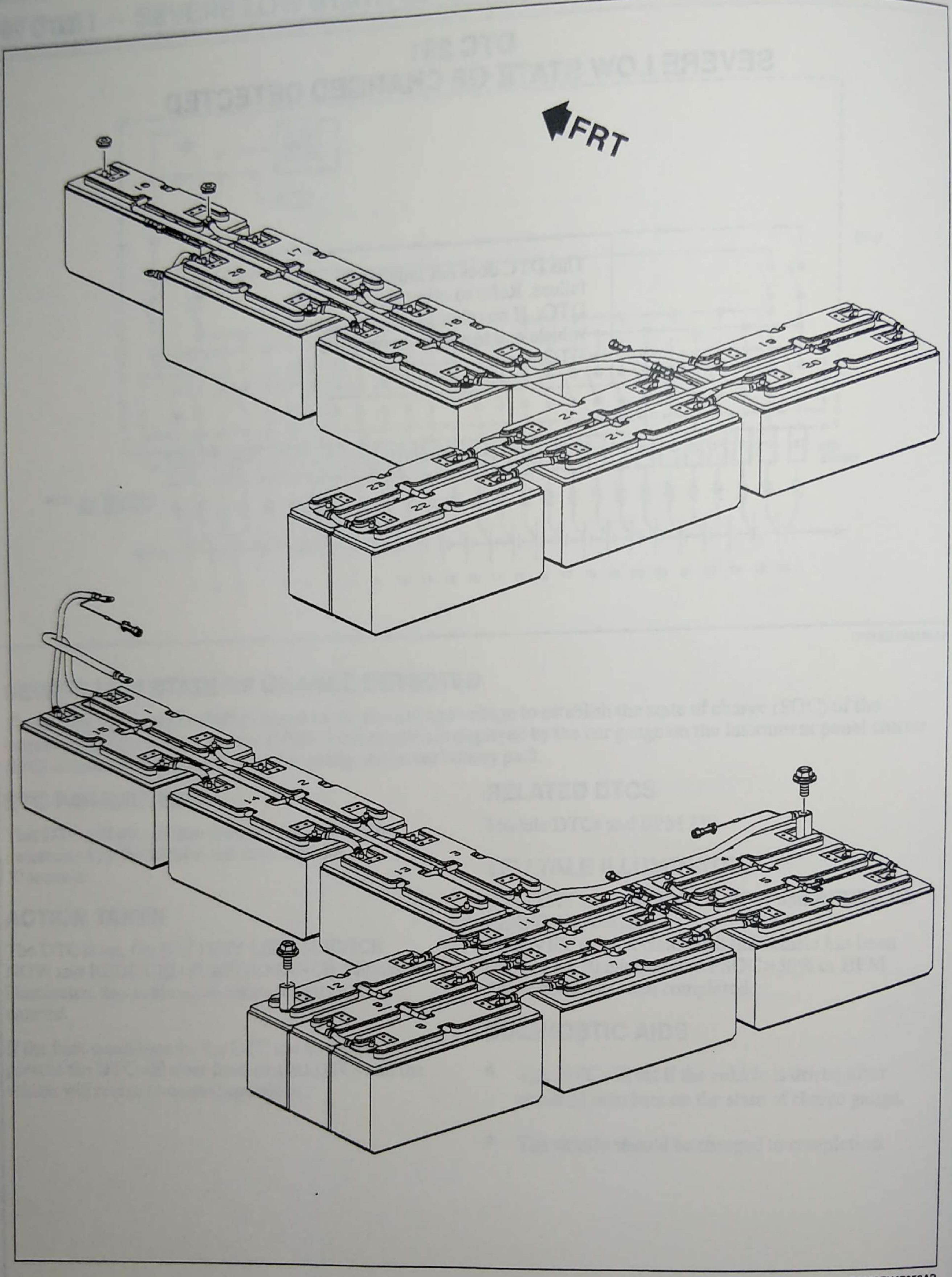
DIAGNOSTIC AIDS

- This DTC will set if the vehicle is driven after reaching zero bars on the state of charge gauge.
- The vehicle should be charged to completion.

DTC 231

SEVERE LOW STATE OF CHARGED DETECTED

This DTC does not indicate a failure. Refer to other stored DTCs. If no other DTCs, charge vehicle and test drive to verify no DTCs reset.


FRT
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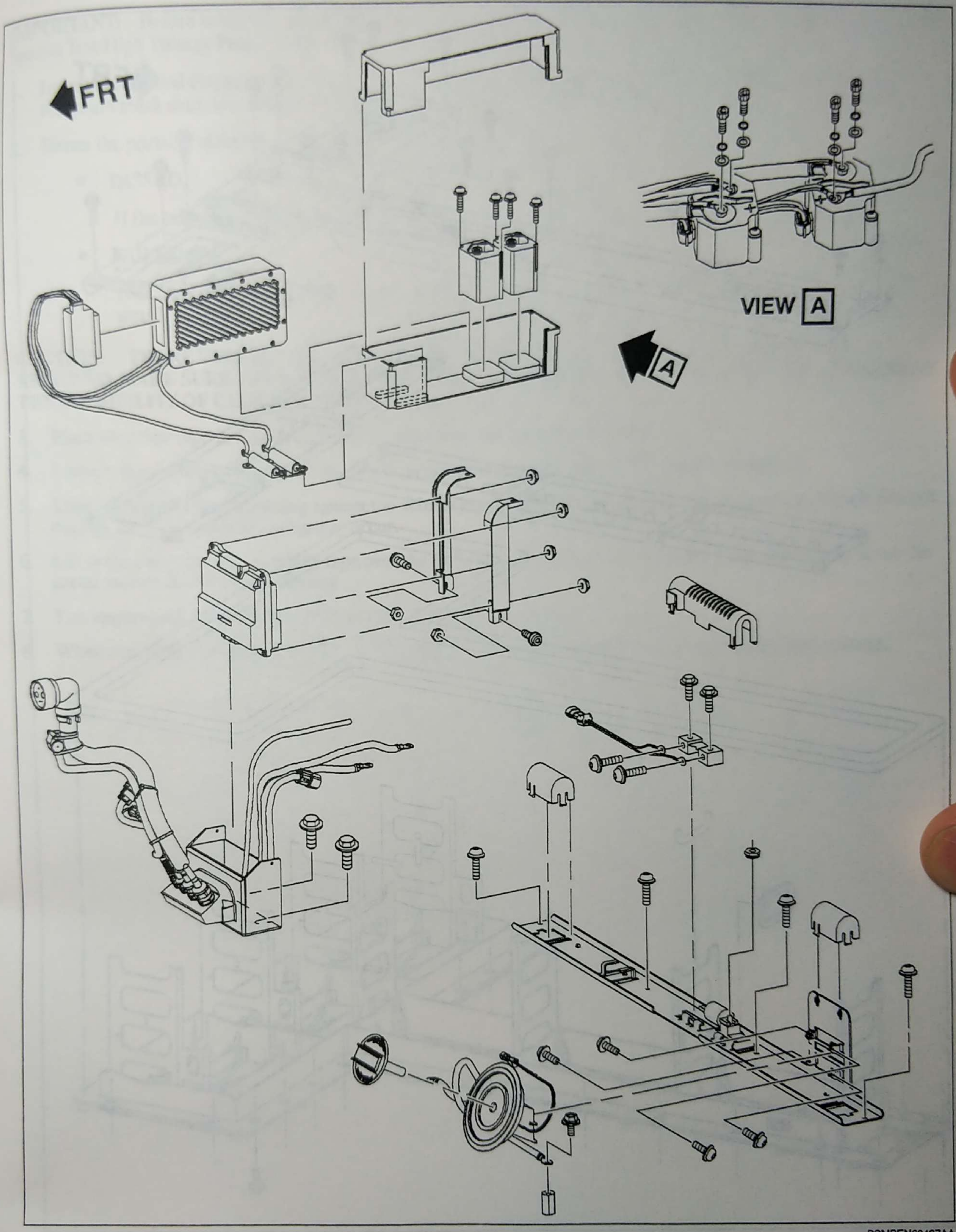

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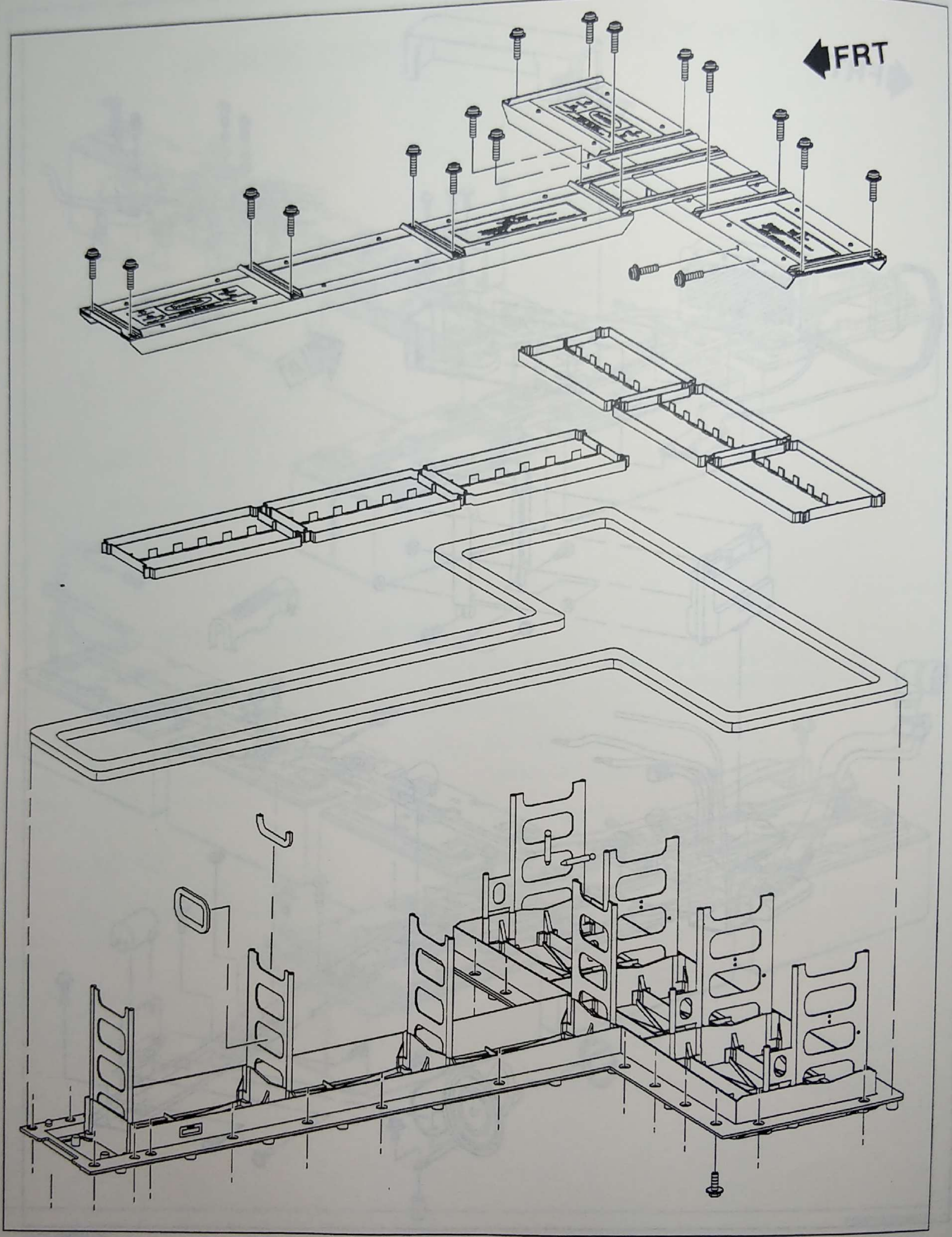

PSMPEN68429AA

RELAY STUCK SHUT PROCEDURE

IMPORTANT: Before using this procedure make sure you have completed trouble tree "Failed High Voltage (HV) Special Test/High Voltage Present With Relays Commanded Open."

1. Install the manual disconnect knob and power the vehicle On and then remove the manual disconnect. If the relays are stuck shut, an attempt to cycle the relays may cause them to open.
2. Rerun the portable diagnostic tool (PDT) HV special test.
   - PASSED

     If the test passed, run it again, if it still passes relays have opened. Finish HV disable procedure
   - FAILED

     If the test failed repeat step 1 and 2. If after a second attempt to open relays has failed, continue to step 3.

CAUTION: THERE WILL BE VOLTAGE PRESENT WHEN THE BATTERY PACK CONNECTOR IS REMOVED. MAKE SURE THE FOLLOWING PROCEDURES ARE FOLLOWED STEP BY STEP TO PREVENT THE POSSIBILITY OF CAUSING CURRENT FLOW.

3. Place electrical tape in a accessible area for removing the cannon connector.
4. Loosen, but do not remove the battery pack to power inverter module (PIM) cannon connector.
5. Using one hand and not leaning against the vehicle carefully unscrew the connector and pull strait back. Do not cock or turn connector or arcing may occur.
6. Using the electrical tape carefully tape over the end of the connector with a couple of layers and fully cover the metal part of the connector housing.
7. The battery pack can now be removed and the relay(s) replaced.
8. When removing the battery pack, handle the high voltage harness carefully, it does have live high voltage.

BATTERY MODULE REPLACEMENT

REPLACING BATTERY MODULES

If a battery module requires replacement, all battery modules should be evaluated. If any other battery modules have set marginal, out-of-range, undervoltage or severe undervoltage diagnostic trouble codes (DTCs), they should also be replaced.

BATTERY MODULE EVALUATION

a. Using the portable diagnostic tool (PDT), view the four "charge event history records."

b. Check the "PSOC Start" on each of the records and see if any of them are below 30%.

c. If "pack state of charge (PSOC) Start" is NOT below 30 percent on at least one of the "charge event history records" drive vehicle and when you reach 50 percent PSOC do some heavy accelerations and watch for battery module DTCs to set.

d. Continue to drive vehicle with periodic heavy accelerations until only one state of charge (SOC) bar is left. If any module DTCs set, replace these battery modules in addition to the failed battery module.

Before any modules are removed from the battery pack charge the battery pack to completion. If time permits equalize (level) the batteries to ensure all batteries have been fully charged.

IMPORTANT: If battery pack and modules are not charged before replacement this may prevent vehicle operation and/or charging due to a large battery module voltage spread. If the vehicle operation and/or charging is operational it will increase charge times and may damage some of the battery modules due to a voltage spread causing some of the modules to be overcharged.

1. Make sure battery pack temperature at time of replacement is 20–40°C (68–104°F).
2. Replacement modules should also be charged if they are below 12.5 volts. Place the module on the charger set the voltage of the charger to 15.0 volts and the maximum current to 5.0 amps. If battery module input current has not reached 0.5 amps after four hours take the battery off charge and install in the battery pack.
3. Battery module temperature should also be in the range of 20–40°C (68–104°F) for replacement.
4. When battery module replacement is complete charge battery pack to completion. If more than two modules are replaced the pack should be equalized (leveled).
5. Equalized (leveling) can be initialize by using the Saturn service stall system (SSS) under utilities, EE programming and setting leveling to Yes.

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BATTERY PACK SYSTEM TEST

NOTICE: **If this test is not run and the sense leads are connected incorrectly, battery pack module (BPM) damage will occur when the vehicle is placed in the run mode or BPM receives the wake-up signal.**

1. When new modules have been installed, assemble the battery pack (BP) except for the top covers.
2. Remove the two top BPM bracket bolts.
3. Loosen the two TORX™ bolts where the BPM attaches to the nose cone cable housing. When the bolts are loose the BPM will slide up from the nose cone cable housing.

CAUTION: **THE BPM J1 CONNECTOR HAS HIGH VOLTAGE (HV). CAREFULLY DISCONNECT CONNECTION PULLING STRAIT REARWARD. DO NOT TOUCH PINS OR PLACE ANYTHING ACROSS THE PINS OF THE CONNECTOR.**

4. Disconnect the battery pack module (BPM) high voltage (HV) J1 connector. This is the connector closest to the battery modules and when disconnected has a red end.
5. Plug the connector from the BPM HV harness into the BPM pinout tester EV9725Z.
6. Plug the DVOM leads into the BPM pinout test box EV9725Z. Place the meter in the DC voltage position.

IMPORTANT: Make sure the polarity of the meter leads, positive lead to positive port and negative lead to negative port, are correct.

7. Make sure all module leads are installed and then install the manual disconnect knob.
8. Using the rotary switches check the voltage of each module. Voltage should be around 12 volts and positive. If the reading is greater than 15 volts or is a negative reading the sense leads to that module are incorrect.
9. Fix the incorrect sense leads and rerun the test.
10. When all modules have the correct voltage readings remove the manual disconnect knob.
11. Reconnect the BPM HV J1 connector to the BPM.
12. Install the BPM

Torque: **Top BPM bolts: 10 N•m (89 in–lbs)**
Lower BPM bolts: 3 N•m (27 in–lbs)

13. Install the PEB to BP jumper harness EV9714Z and the breakout box EV9734Z between vehicle and BP.
14. Install the manual disconnect knob.
15. Place the vehicle in the Run mode. Clear DTCs and cycle vehicle to Lock, then to Run.
16. Check for BPM DTCs if present refer to the DTC(s) set.
17. In no DTCs set place the vehicle in the Lock mode and remove manual disconnect knob, jumper harness, and pinout box.

BATTERY VENT SYSTEM CHECK OUT

After servicing the battery pack, the vent system integrity must be checked for restrictions and leaks. If the vent system is not working properly, gases may build up in the battery tunnel.

1. Visually inspect all areas where service has been performed. Make sure no vent lines are pinched or misrouted.
2. Disconnect the filter from the front of pack vent tube, attached to the high voltage (HV) harness just below cannon connector, and attach a standard hand operated (pressure/vacuum) pump.
3. Disconnect the outside vent cap on the module nearest the area that needed service (refer to chart on next page). Attach a second pressure/gauge to the exposed vent port.

IMPORTANT: Refer to chart for proper gauge location according to the module serviced.

4. Pump between 2 and 4 psi of pressure on the vent harness. Pressure should hold steady for five minutes without dropping, this verifies there are no leaks in the system.
5. Verify pressure readings between the two gauges are the same within 2 psi. If the readings differ, there is restriction someplace in the vent harness. Most likely the restriction is in the area that was last serviced.
6. Relieve pressure, pump up a second time and watch the rate of climb between the two gauges. Vacuum gauges should mirror each other closely (within 1 psi) on a properly functioning vent system. If gauge at the battery module is slow to react, there is a restriction in the vent system. Locate restriction and repair. Rerun test.
7. Remove pressure gauge from the outside of module and install a new cap on module.

NOTICE: Cap may have been damaged when it was removed. Install a new cap to insure proper vent system integrity.

8. Pump up for a third time to insure there are no leaks at the cap.
9. If system checks out, remove/pressure vacuum pump and reinstall filter to vent harness. Be sure the filter is properly secured to the high voltage cable.

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MODULE SERVICED	VENT POSITION TO CHECK
Module 1	Vent cap 1
Module 2	Vent cap 2
Module 3	Vent cap 3
Module 4	Vent cap 4
Module 5	Vent cap 6
Module 6	Vent cap 6
Module 7	Vent cap 7
Module 8	Vent cap 8
Module 9	Vent cap 8
Module 10	Vent cap 7
Module 11	Vent cap 7
Module 12	Vent cap 12
Module 13	Vent cap 13
Module 14	Vent cap 14
Module 15	Vent cap 15
Module 16	Vent cap check with front top cover removed at 16
Module 17	Vent cap check with front top cover removed at 17
Module 18	Vent cap check with front top cover removed at 18
Module 19	Vent cap check with front top cover removed at 19
Module 20	Vent cap check with front top cover removed at 20
Module 21	Vent cap check with front top cover removed at 21
Module 22	Vent cap check with front top cover removed at 22
Module 23	Vent cap check with front top cover removed at 23
Module 24	Vent cap check with front top cover removed at 24
Module 25	Vent cap check with front top cover removed at 25
Module 26	Vent cap check with front top cover removed at 26

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HIGH VOLTAGE JUMPER HARNESS TOOL #EV9714Z

REMOVAL

CAUTION: TO REDUCE THE RISK OF SEVERE SHOCKS AND BURNS, THE HIGH VOLTAGE SYSTEM SHOULD BE DISABLED ANY TIME SERVICE WORK IS BEING PERFORMED ON OR AROUND THE HIGH VOLTAGE SYSTEM. WHEN IN DOUBT, ALWAYS DISABLE THE HIGH VOLTAGE SYSTEM. THE 12 VOLT SYSTEM WILL STILL BE ACTIVE AFTER THE HIGH VOLTAGE SYSTEM HAS BEEN DISABLED.

1. Disable the high voltage system. (Refer to "High Voltage Disable/Enable" procedure in this manual.)
2. Before removing the jumper tool make sure the voltage reading on the tool is zero volts. Remove the jumper harness tool to PIM cannon connector from the back right of the power inverter module (PIM).
3. Remove the high voltage jumper harness tool to battery pack harness cannon connector.
4. Install the battery pack to PIM cannon connector to the back right of the PIM.

NOTICE: Do not use any tools to reinstall the connector. Excessive force or misalignment can damage the connector pins.

5. Enable the high voltage system. (Refer to "High Voltage Disable/Enable" procedure in this manual.)

INSTALLATION

CAUTION: TO REDUCE THE RISK OF SEVERE SHOCKS AND BURNS, THE HIGH VOLTAGE SYSTEM SHOULD BE DISABLED ANY TIME SERVICE WORK IS BEING PERFORMED ON OR AROUND THE HIGH VOLTAGE SYSTEM. WHEN IN DOUBT, ALWAYS DISABLE THE HIGH VOLTAGE SYSTEM. THE 12 VOLT SYSTEM WILL STILL BE ACTIVE AFTER THE HIGH VOLTAGE SYSTEM HAS BEEN DISABLED.

1. Disable the high voltage system. (Refer to "High Voltage Disable/Enable" procedure in this manual.)
2. When high voltage system disable is complete remove the battery pack to PIM cannon connector from the back right of the PIM.
3. Install the high voltage jumper harness tool cannon connector to the back of the PIM.

NOTICE: Do not use any tools to reinstall the connector. Excessive force or misalignment can damage the connector pins.

4. Install the high voltage jumper harness tool cannon connector to the battery pack harness.

NOTICE: To prevent connector damage make sure connectors are lined up before turning the connector into place. Do not use tool to install the cannon connectors.

MAINTAINING INDIVIDUAL BATTERY MODULES

Battery modules should be stored in conditions from 10°–35°C (50°–95°F). Modules stored at temperatures below 10°C (50°F) could freeze and cause irreversible damage. Modules stored above 35 will exhibit higher self-discharging rates and irreversible damage is possible if modules are severely discharged.

Battery modules should be completely recharged every four weeks. Modules which are recharged less frequently may develop irreversible damage and have reduced performance and life.

CHARGE PROCEDURE

1. Connect the battery charger to the battery module. Positive lead to positive terminal and negative lead to negative terminal.
2. The voltage level should be set to 15 volts and the maximum current set to five amps.
3. Charge the battery module until the current input reaches 0.5 amps or four hours whichever occurs first.
4. Repeat this procedure every four weeks.

CHARGE PROCEDURE FOR PROGRAMABLE CHARGER

1. Connect the battery charger to the battery module. Positive lead to positive terminal and negative lead to negative terminal.
2. Program in the following charging criteria:

CHARGE STEP	CURRENT LIMIT (A)	VOLTAGE LIMIT (V)	TIME (HRS)
1	15.0	15.0	To voltage limit
2	7.5	15.0	To voltage limit
3	4.0	15.0	To voltage limit
4	2.0	15.0	To voltage limit
5	1.0	15.0	To voltage limit
6		15.0	Four hours or current<0.2 amps

3. Repeat this procedure every four weeks.

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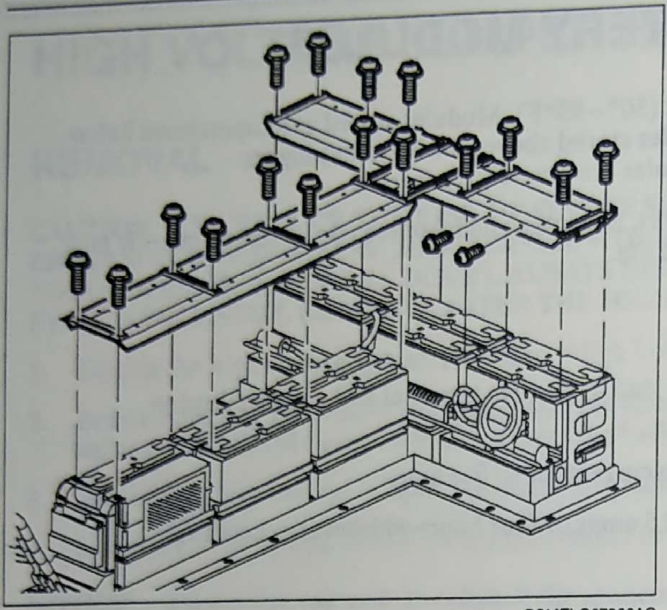

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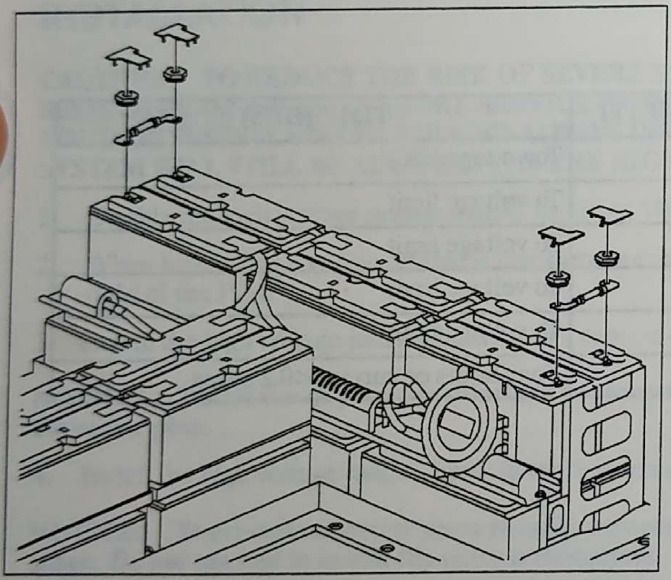

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TOP LAYER BATTERY MODULES (BATTERY MODULES 16 – 26)

REMOVAL

IMPORTANT: Before any battery modules are replaced the battery pack must be fully charged and the replacement modules must be above 12.5 volts. (Refer to "Battery Module Replacement" procedure.)

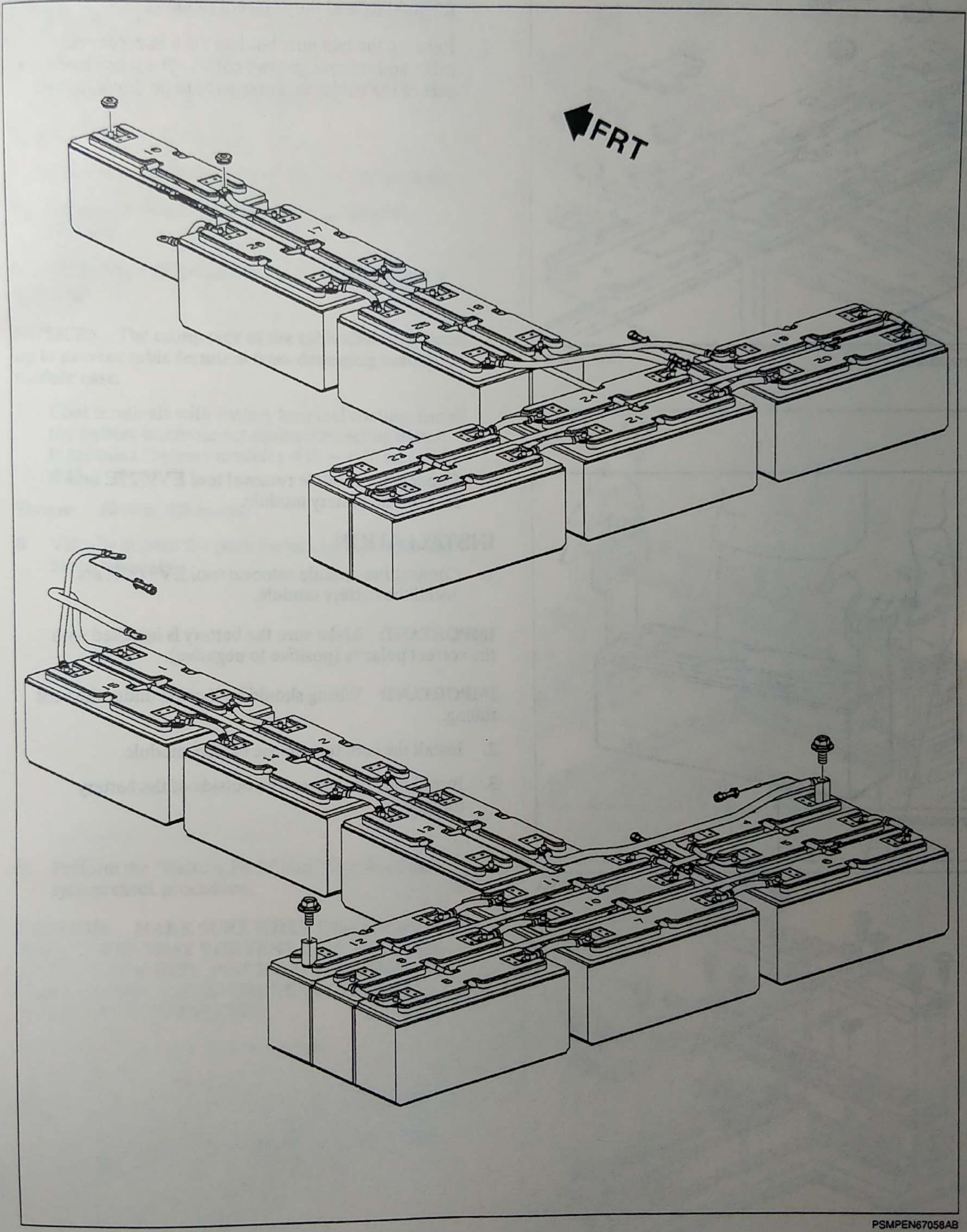
1. Remove the battery pack from the vehicle. (Refer to "Battery Pack" removal in this manual.)

CAUTION: WITH THE BATTERY PACK OUT OF THE VEHICLE YOU ARE EXPOSED TO HIGH VOLTAGE. NEVER LEAN ON THE BATTERY PACK OR TOUCH THE BATTERY BACK WITH BOTH HANDS. FOLLOW ALL PROCEDURES STEP BY STEP.

2. Remove the top covers on the battery pack.

NOTICE: When servicing modules 19 through 24, remove only the rear battery pack top cover.

3. Remove the battery interconnect cables connecting battery terminals at battery module #19 – #20 and #22 – #23. This further breaks down the voltage potential of the battery pack.
4. Locate the module required for replacement. (See art on next page.)



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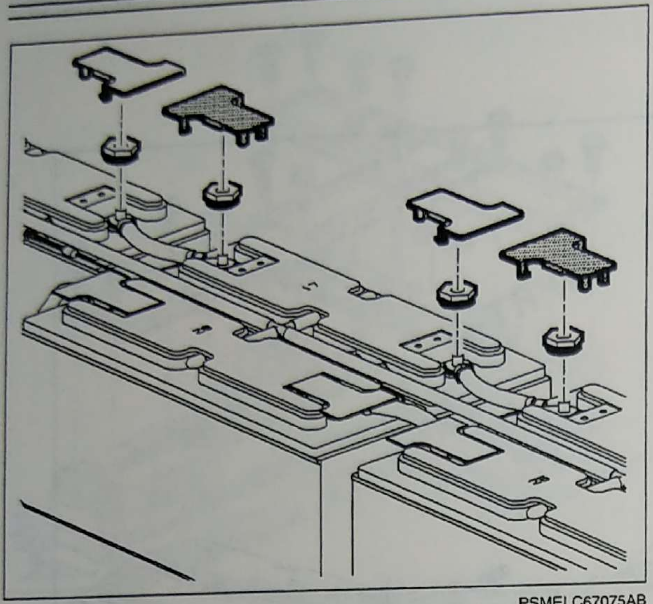

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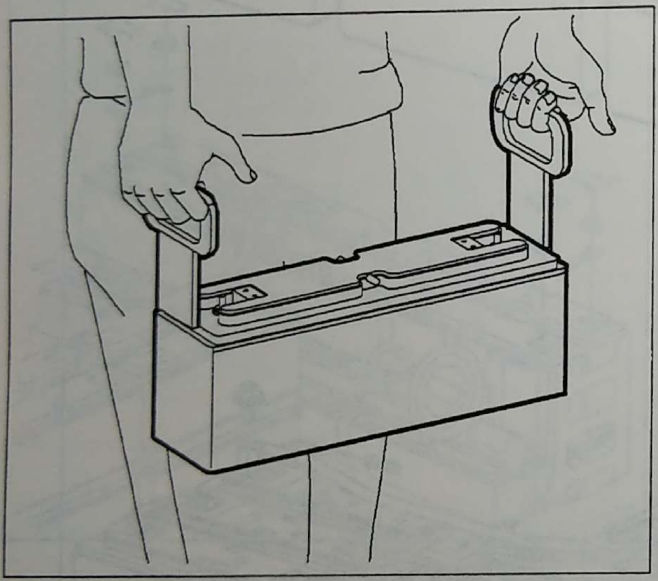
5. Remove the vent tube connected to the battery module.
6. Remove the positive and negative terminal covers of the module and the adjacent modules.
7. Remove the two nuts holding each interconnect cable and remove the two cables. The sense leads are part of the cables and may have to be disconnected.



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8. Connect the module removal tool EV9727E and remove the battery module.

INSTALLATION

1. Connect the module removal tool EV9727E and install the battery module.

IMPORTANT: Make sure the battery is installed with the correct polarity (positive to negative).

IMPORTANT: Wiring should be located under the vent tubing.

2. Install the vent tube to the battery module.
3. Install the vent cap on the outside of the battery module.

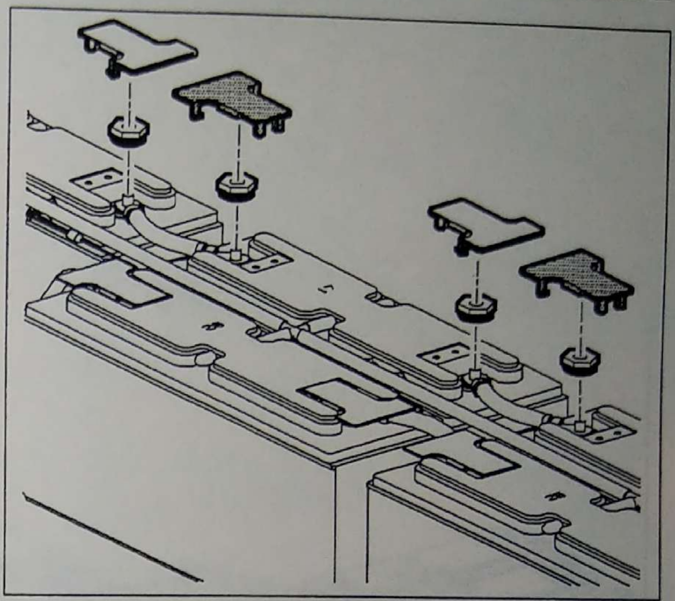
IMPORTANT: Make sure hex side of clincher nut is facing up.

NOTICE: The crimp side of the cable should be facing up to prevent cable terminal from damaging battery module case.

4. Coat terminals with battery terminal coating. Install the two interconnect cables and nuts.

Torque: **10 N•m (89 in-lbs)**

5. Install the terminal covers on the battery modules.
6. Inspect the vent tube harness for binding or pinching.



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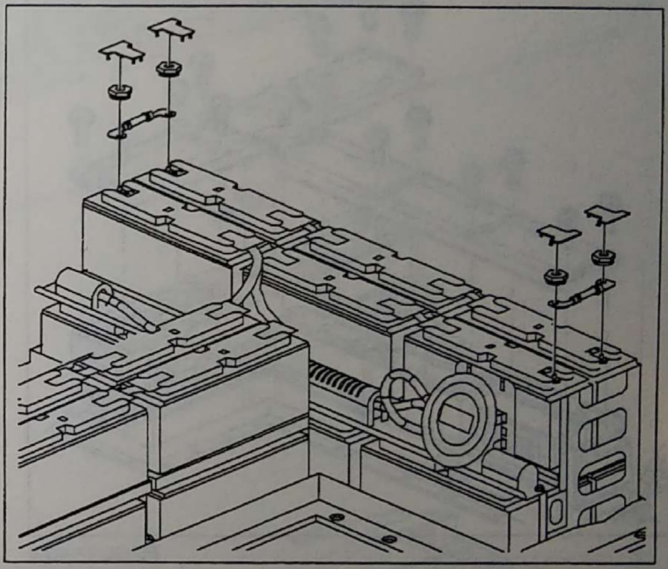
IMPORTANT: Make sure hex side of clincher nut is facing up.

NOTICE: The crimp side of the cable should be facing up to prevent cable terminal from damaging battery module case.

7. Coat terminals with battery terminal coating. Install the battery interconnect cables connecting battery terminals at battery modules #19 – #20 and #22 – #23.

Torque: **10 N•m (89 in-lbs)**

8. Visually inspect the pack for pinched/broken vent tubes, wiring etc.



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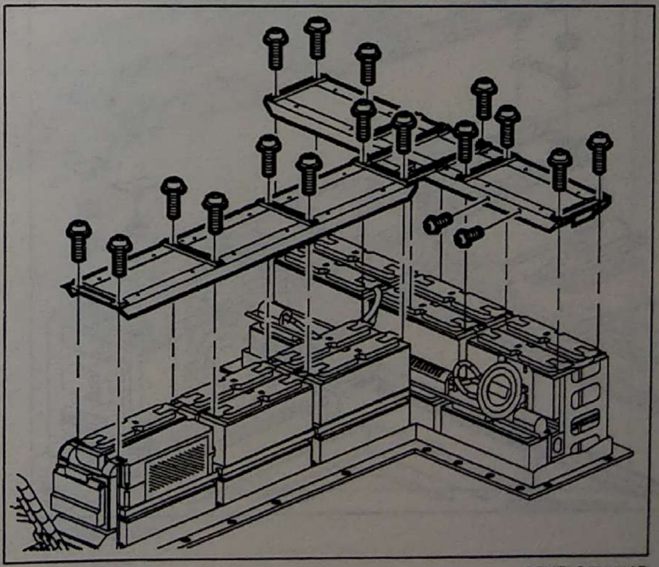
9. Perform the “Battery Pack” and “Vent Harness” system check procedures.

CAUTION: MAKE SURE WHEN INSTALLING THE TOP COVERS THAT THE VENT HARNESS DOES NOT GET PINCHED. PINCHING THE VENT HARNESS MAY CAUSE THE VENT SYSTEM TO FUNCTION INCORRECTLY.

10. Install the battery pack top covers.

Torque: **10 N•m (89 in-lbs)**
(3 N•m [27 in-lbs] top cover to manual disconnect)

11. Install the battery pack. (Refer to “Battery Pack” installation procedure in this manual.)



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BOTTOM LAYER BATTERY MODULES (BATTERY MODULES 1 – 15 EXCEPT 4, 11, AND 12)

REMOVAL

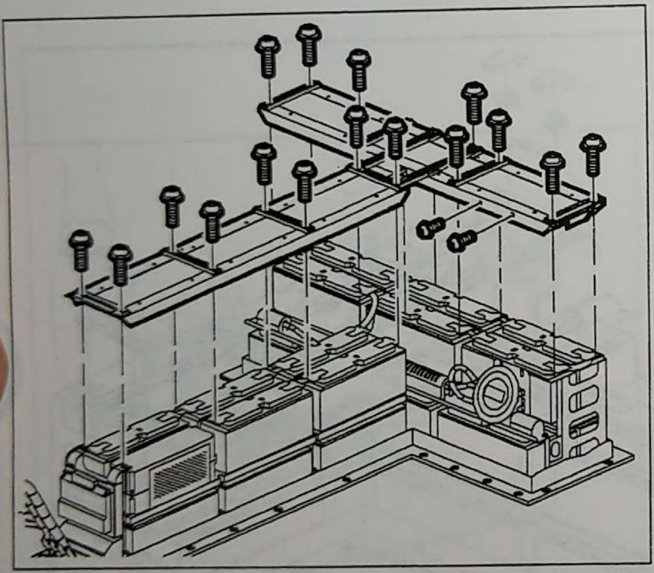
IMPORTANT: Before any battery modules are replaced the battery pack must be fully charged and the replacement modules must be above 12.5 volts. Refer to "Battery Module Replacement" procedure.

1. Remove the battery pack from the vehicle. (Refer to "Battery Pack" removal in this manual.)

CAUTION: WITH THE BATTERY PACK OUT OF THE VEHICLE YOU ARE EXPOSED TO HIGH VOLTAGE. NEVER LEAN ON THE BATTERY PACK OR TOUCH THE BATTERY BACK WITH BOTH HANDS. FOLLOW ALL PROCEDURES STEP BY STEP.

2. Remove the top covers on the battery pack.

IMPORTANT: When servicing modules 4 through 12, Remove only the rear battery pack top cover.



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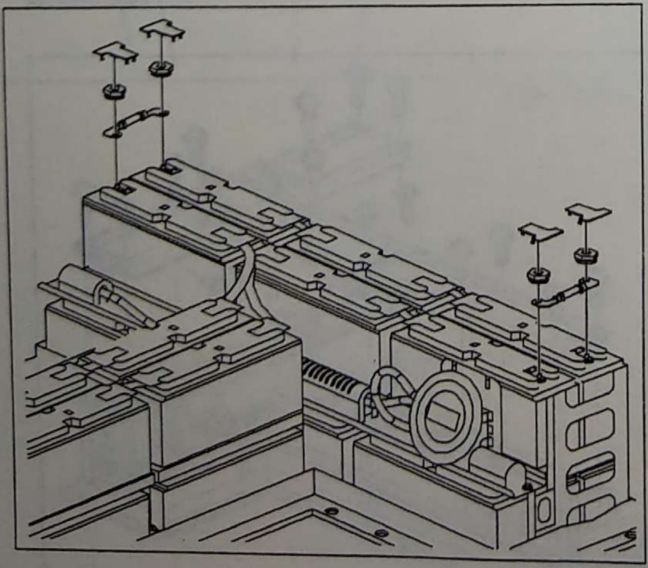
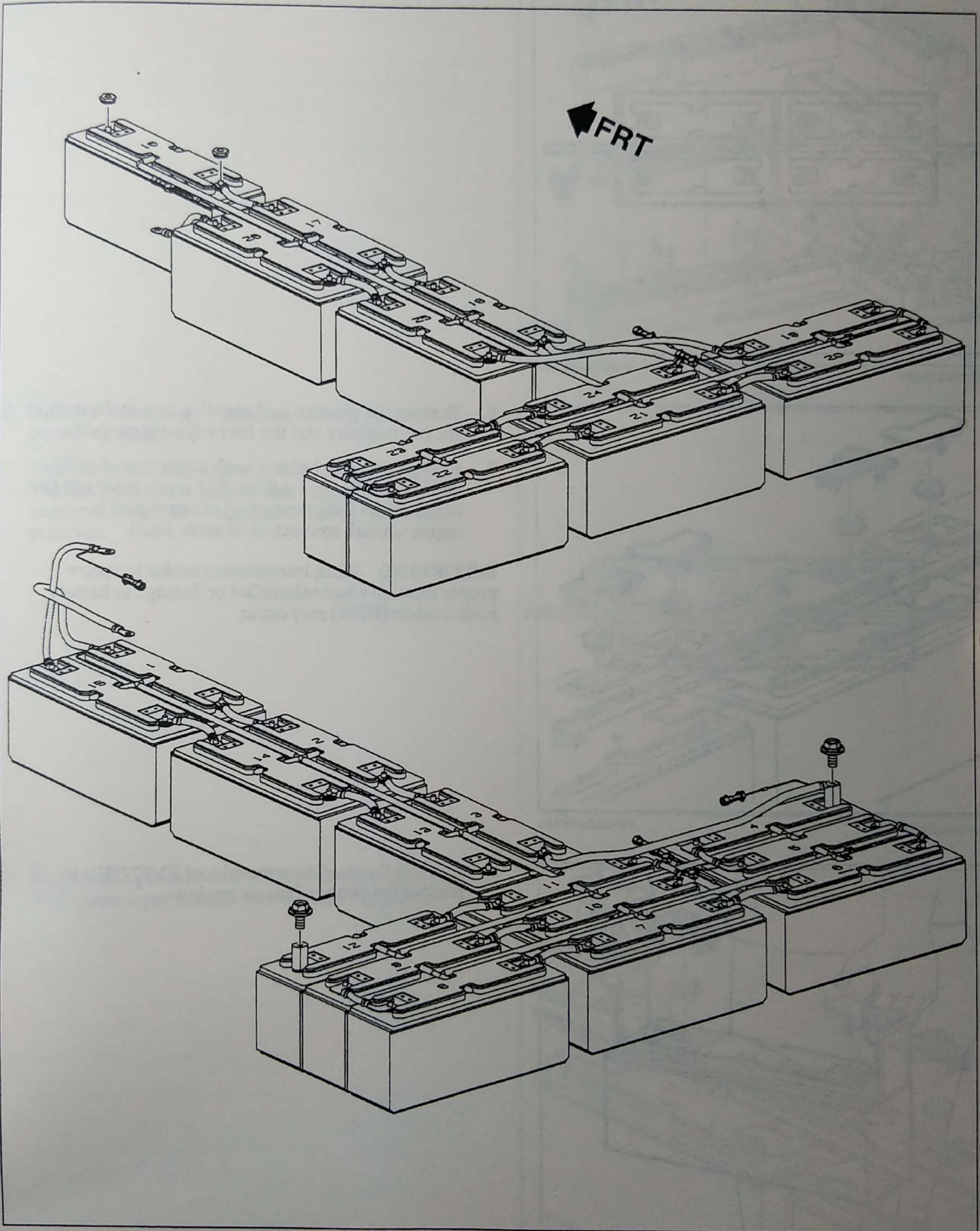


PSMELC67073AB

3. Remove the battery interconnect cables connecting battery terminals at battery module #19 – #20 and #22 – #23. This further breaks down the voltage potential of the battery pack.
4. Locate the bottom module required for replacement. (See art on nest page.)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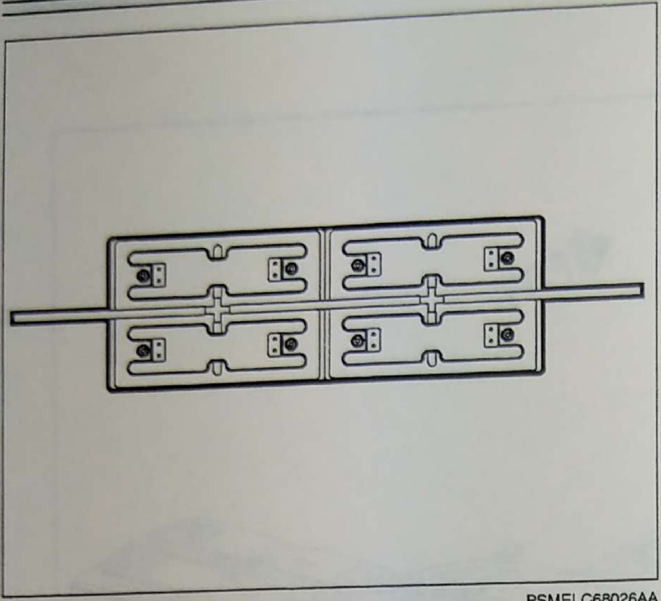
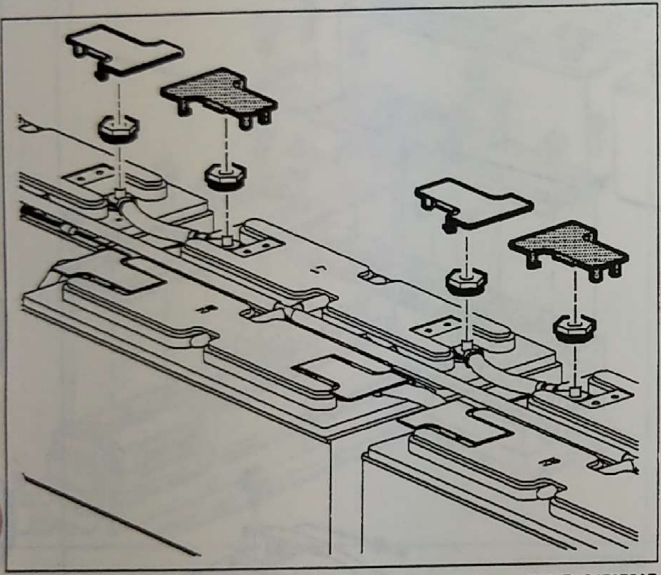
PSMPEN67058AB



PSMELC68026AA

5. Remove the vent tubes on the two modules directly above the battery module that needs to be replaced.

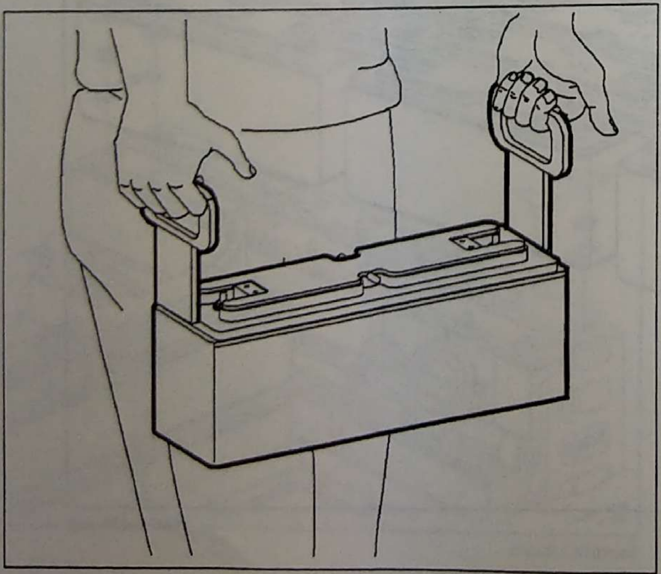


PSMELC67075AB

6. Remove the positive and negative terminal covers of the two modules and the four adjacent modules.

7. Remove the nuts holding each interconnect cable and remove the four cables. The sense leads are part of the cables if disconnecting of sense lead is required mark connectors of sense leads.

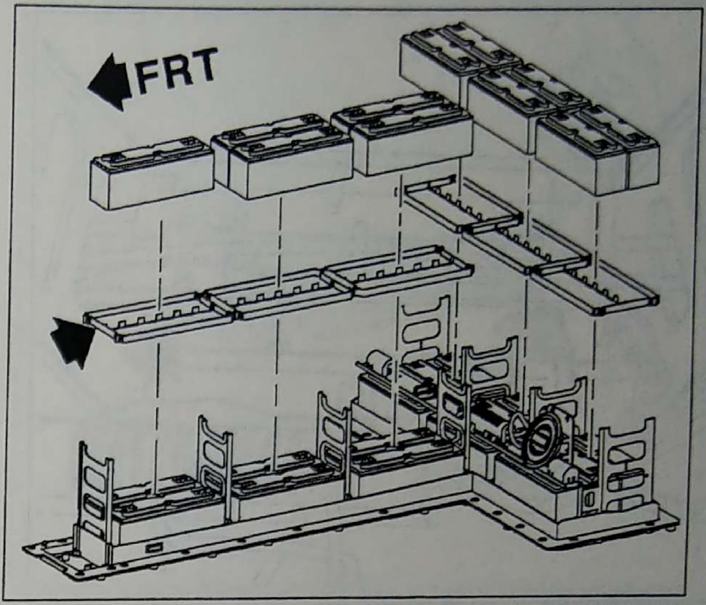
IMPORTANT: Mark interconnect cables to insure proper location when reinstalled or damage to battery pack module (BPM) may occur.



PSMELC68378AA

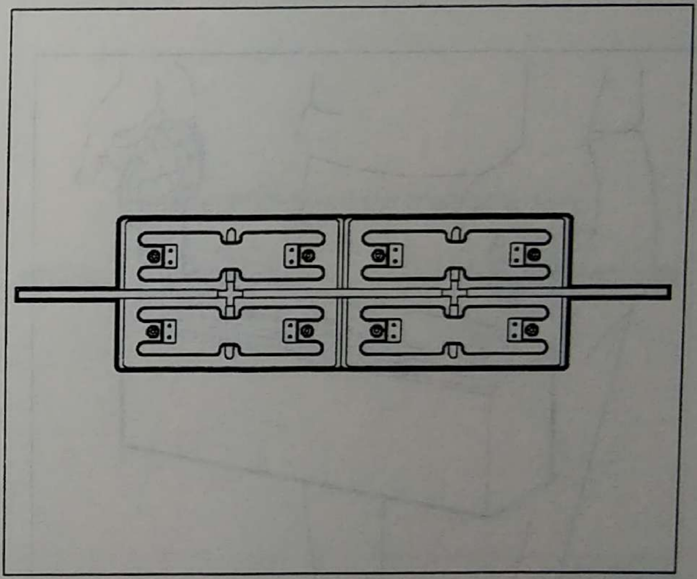
8. Connect the module removal tool EV9727E and remove the two top battery modules.

9. Remove the intermediate tray.



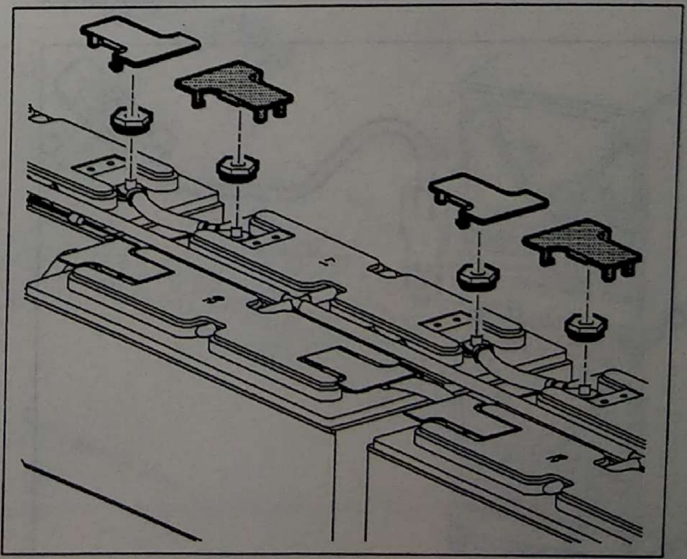
PSMELC67074AA

10. Remove the vent tube connected to the bottom battery module.
11. Tape loose wires and vent tube away from module. This is to prevent wiring or vent tubing from getting damaged when the bottom layer battery module is removed.



PSMELC68026AA

12. Remove the positive and negative terminal covers of the bottom layer module that is being replaced.



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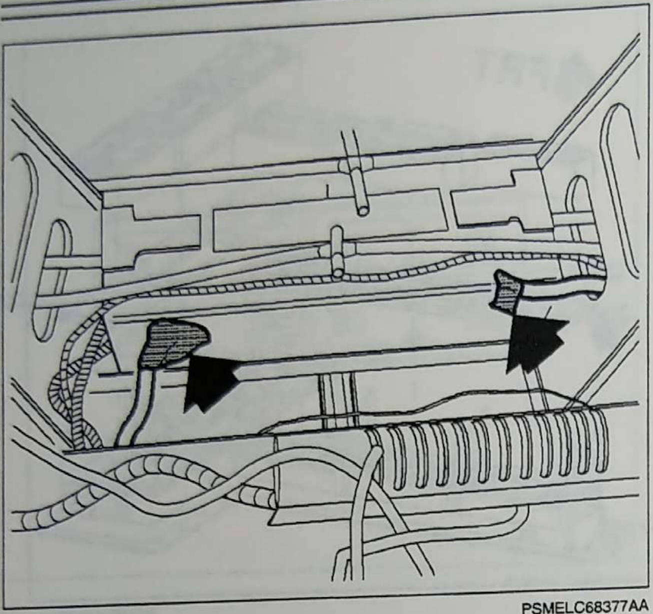
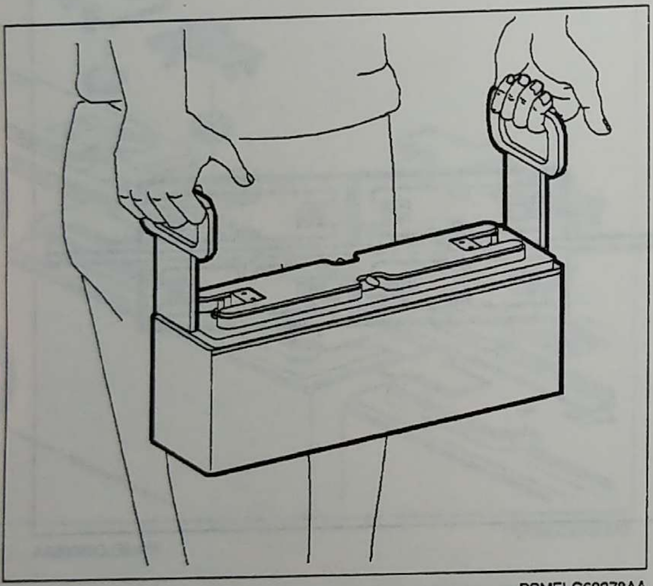


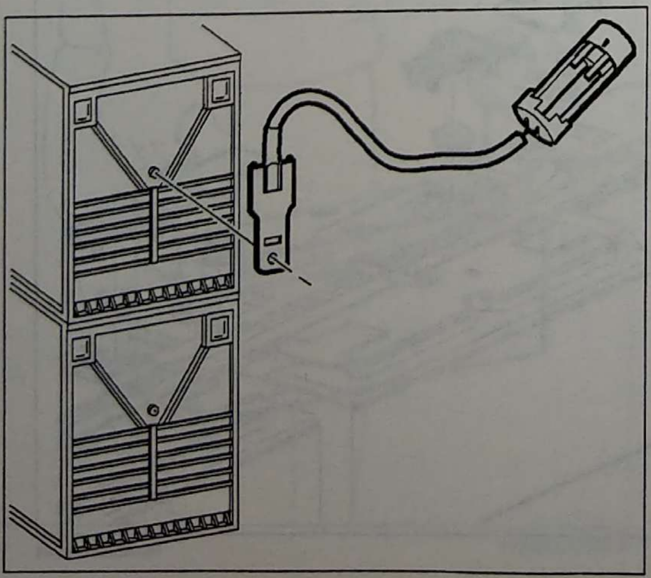
PSMELC68377AA

13. Remove the nut holding each interconnect cable end of the module being replaced. Remove the cable from terminal. Fully tape cable end and locate to the side.
14. Disconnect thermal sensor harness if applicable. Modules 1, 3, 4, 6, 9 and 10 have temperature sensors.



PSMELC68378AA

15. Position wires and vent tube away from module. Connect the module removal tool EV9727E and remove the battery module.



PSMELC67062AA

16. Remove thermal sensor from the side of the battery if replacing module(s) 1, 3, 4, 6, 9, or 10.

INSTALLATION

IMPORTANT: Install thermal sensor if applicable.

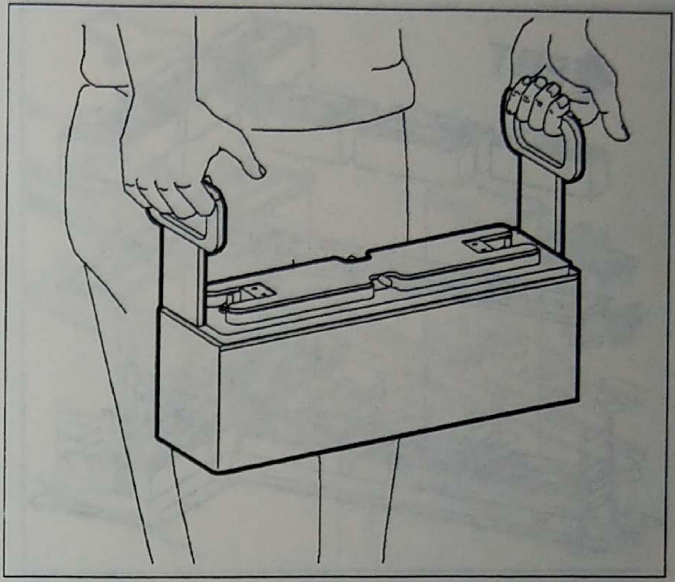
1. Connect the module removal tool EV9727E and install the battery module.

IMPORTANT: Make sure the battery is installed with the correct polarity (positive to negative).

2. Remove tape from vent tube and sense wires but NOT interconnect cable.

IMPORTANT: All sense leads (wires) should be routed under vent tubing.

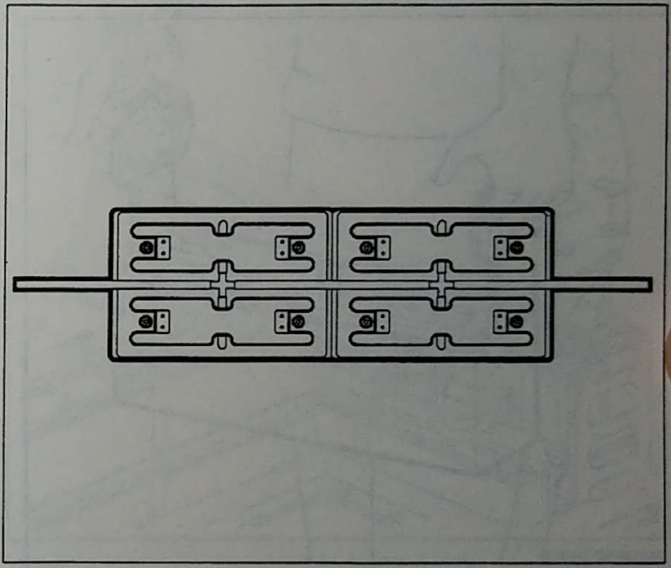
3. Install the vent tube to the bottom battery module.



PSMELC68378AA

IMPORTANT: Modules 5, 9, and 10 have vent tubes installed on both sides of module.

4. Install the vent cap on the outside of the battery module.



PSMELC68026AA

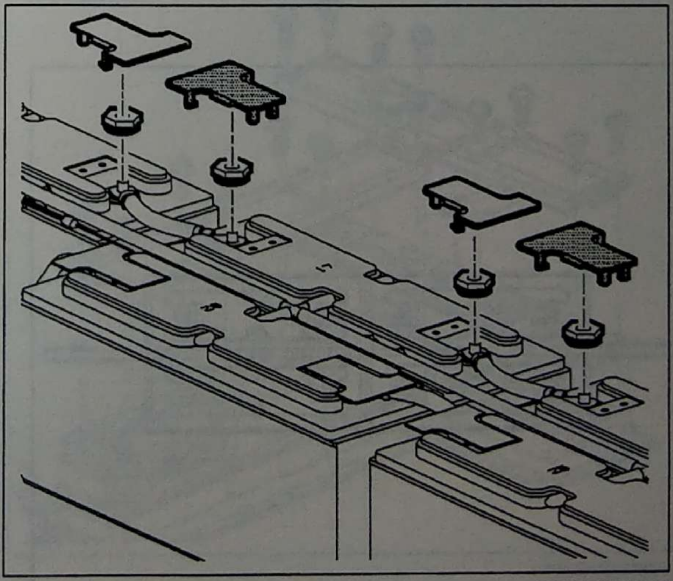
IMPORTANT: Make sure hex side of clincher nut is facing up.

NOTICE: The crimp side of the cable should be facing up to prevent cable terminal from damaging battery module case.

5. Coat terminals with battery terminal coating. Remove tape and install the two interconnect cable ends and nuts.

Torque: 10 N•m (89 in-lbs)

6. Install the terminal covers on the battery module.
7. Inspect the vent tube harness and wiring and make sure they are installed and located so they will not get pinched during reassembly.



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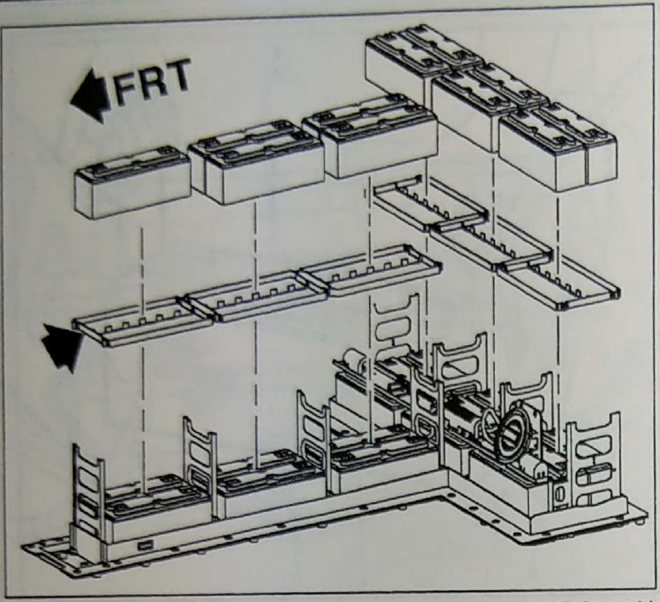
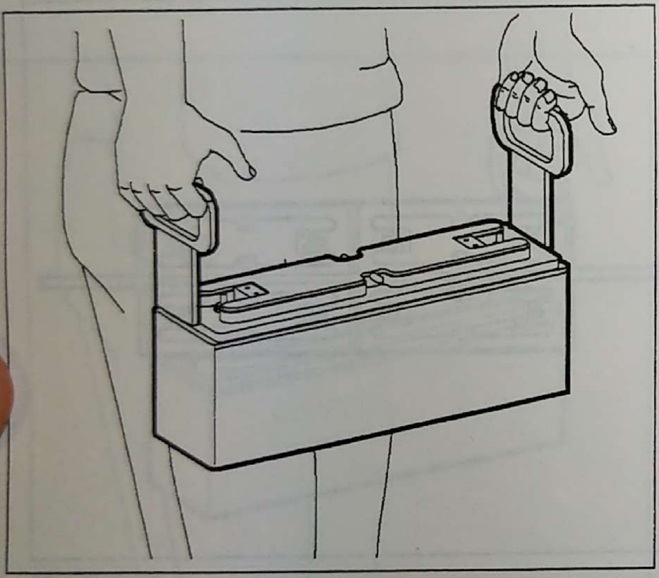


PSMELC67074AA

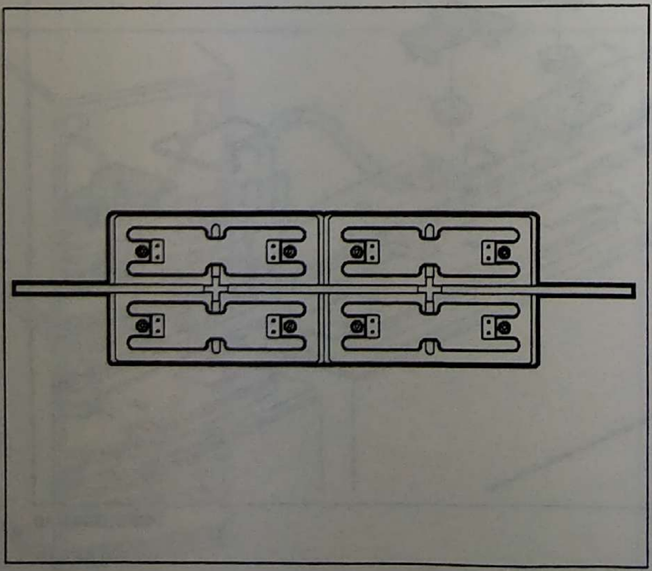
8. Install the intermediate tray.



PSMELC68378AA

9. Connect the module removal tool EV9727E and install the two top battery modules.

IMPORTANT: Make sure the battery is installed with the correct polarity (positive to negative).



PSMELC68026AA

IMPORTANT: All sense lead wires should be located under the vent tube harness.

10. Install the vent tubes to the two battery modules.

IMPORTANT: Make sure vent caps are installed on the outside of the battery module.

IMPORTANT: Make sure hex side of clincher nut is facing up.

NOTICE: The crimp side of the cable should be facing up to prevent cable terminal from damaging battery module case.

11. Coat terminals with battery terminal coating. Install the four interconnect cables (in their original locations) and nuts.

Torque: 10 N•m (89 in-lbs)

12. Install the terminal covers on the battery modules.
13. Inspect the vent tube harness and make sure it is installed and free.

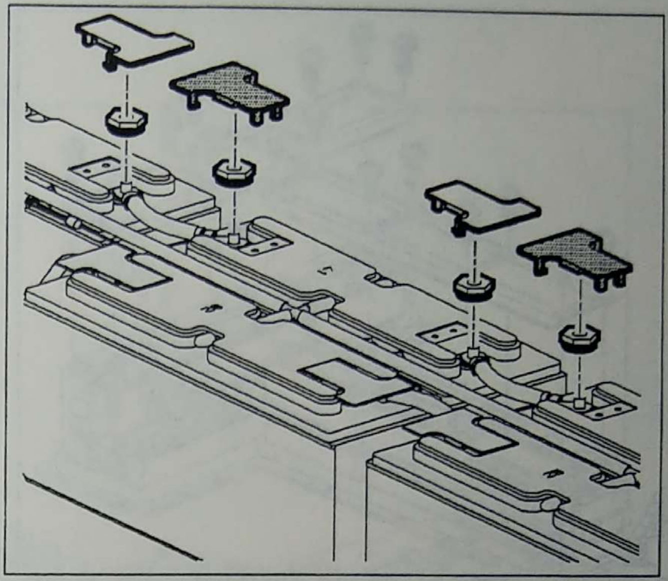
IMPORTANT: Make sure hex side of clincher nut is facing up.

NOTICE: The crimp side of the cable should be facing up to prevent cable terminal from damaging battery module case.

14. Coat terminals with battery terminal coating. Install the battery interconnect cables connecting battery terminals at battery modules #19 – #20 and #22 – #23.

Torque: 10 N•m (89 in-lbs)

15. Visually inspect the pack for pinched/broken vent tubes, wiring etc.



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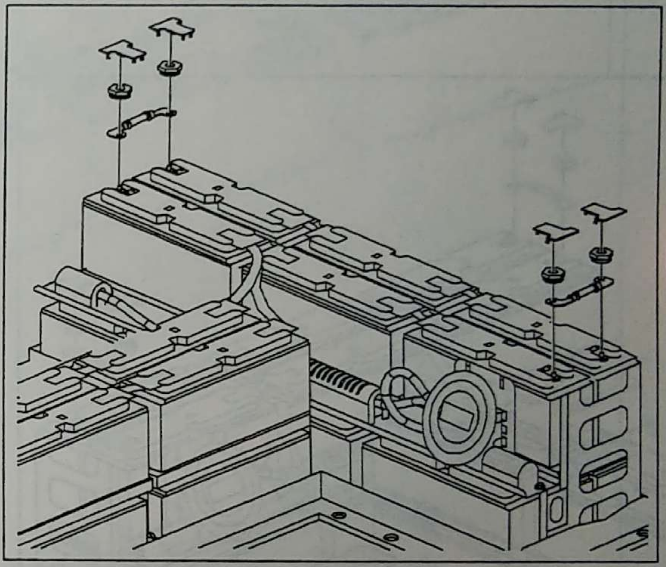


PSMELC67073AB

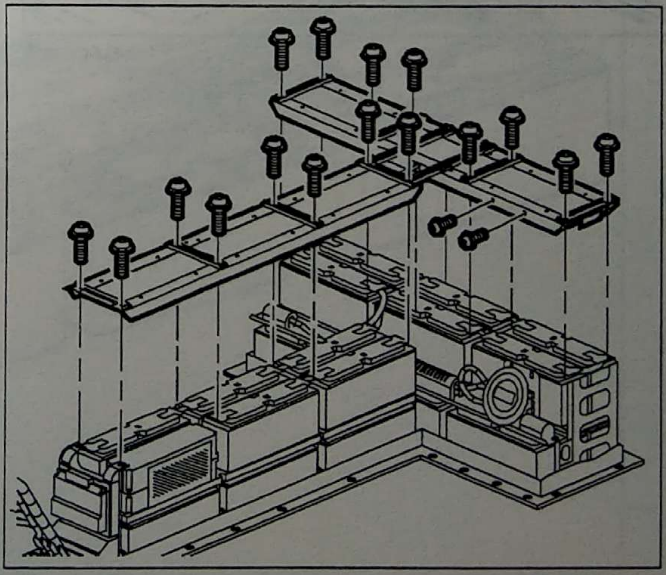
16. Perform the "Battery Pack" and "Vent Harness" system check procedures.

CAUTION: MAKE SURE WHEN INSTALLING THE TOP COVERS THAT THE VENT HARNESS DOES NOT GET PINCHED. PINCHING THE VENT HARNESS MAY CAUSE THE VENT SYSTEM TO FUNCTION INCORRECTLY.

17. Install the battery pack top covers.

Torque: 10 N•m (89 in-lbs)
(3 N•m [27 in-lbs] top cover to manual disconnect)

18. Install the battery pack. (Refer to "Battery Pack" installation procedure in this manual.)



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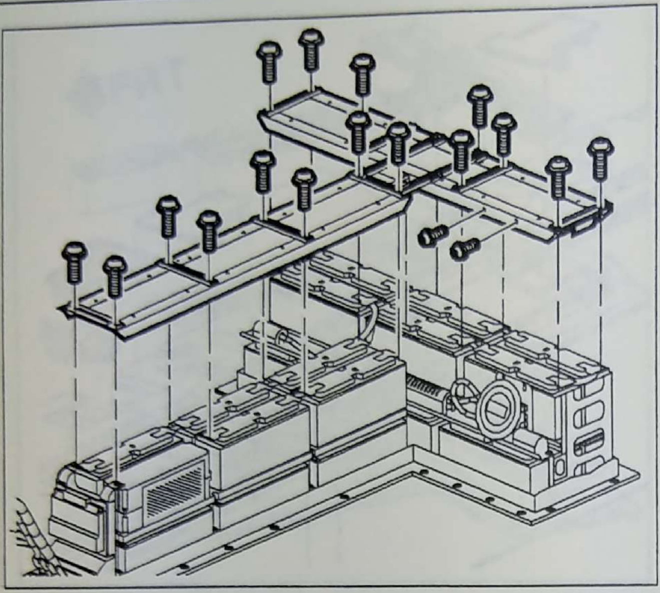

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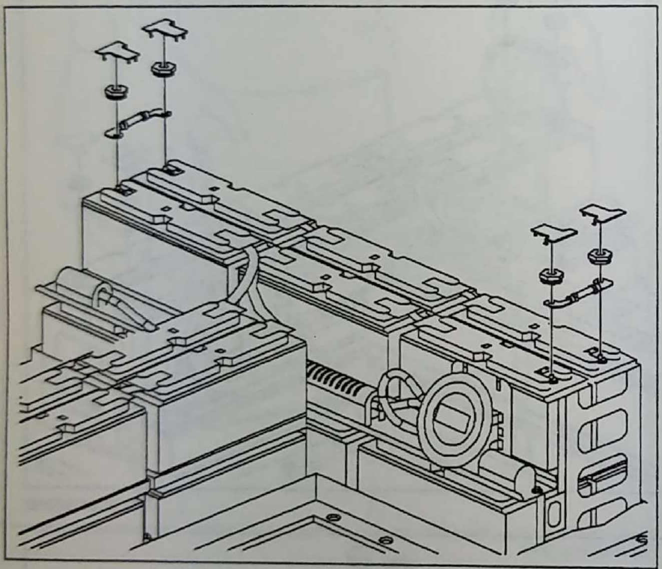


PSMELC67073AB

BATTERY MODULE REPLACEMENT UNDER CROSS BAR (MODULES 4, 11, AND 12)

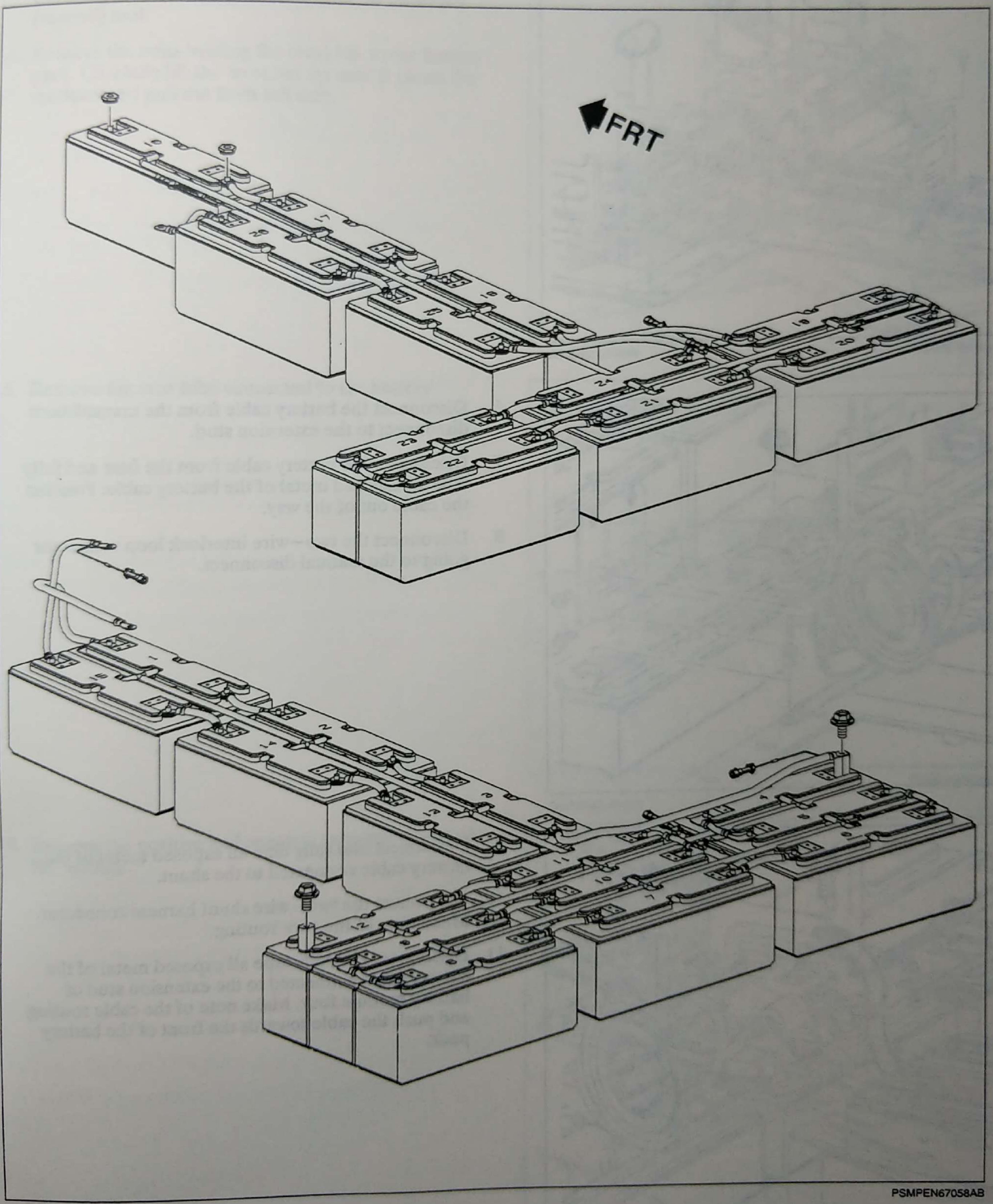
REMOVAL

IMPORTANT: Before any battery modules are replaced the battery pack must be fully charged and the replacement modules must be above 12.5 volts. (Refer to "Battery Removal Module Replacement" procedure.)

1. Remove the battery pack from the vehicle. (Refer to "Battery Pack" removal in this manual.)

CAUTION: WITH THE BATTERY PACK OUT OF THE VEHICLE YOU ARE EXPOSED TO HIGH VOLTAGE. NEVER LEAN ON THE BATTERY PACK OR TOUCH THE BATTERY BACK WITH BOTH HANDS. FOLLOW ALL PROCEDURES STEP BY STEP.

2. Remove the rear top cover only on the battery pack.
3. Remove the battery interconnect cables connecting battery terminals at battery module #19 – #20 and #22 – #23. This further breaks down the voltage potential of the battery pack.
4. Locate the module required for replacement. (See art on next page.)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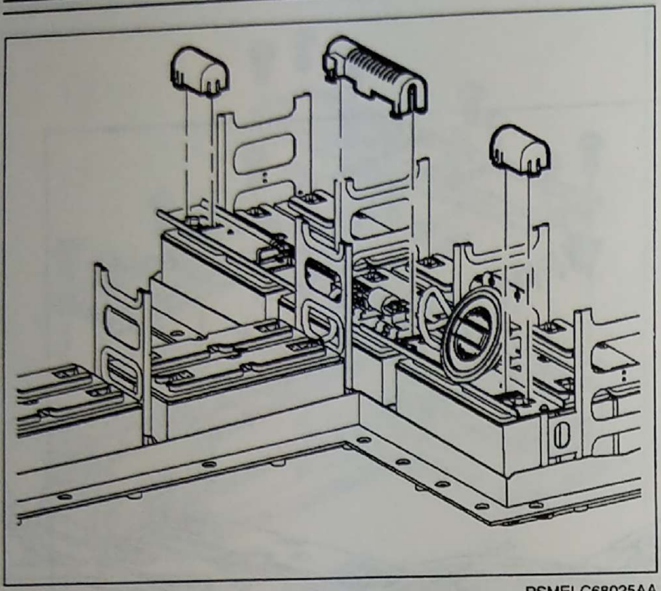
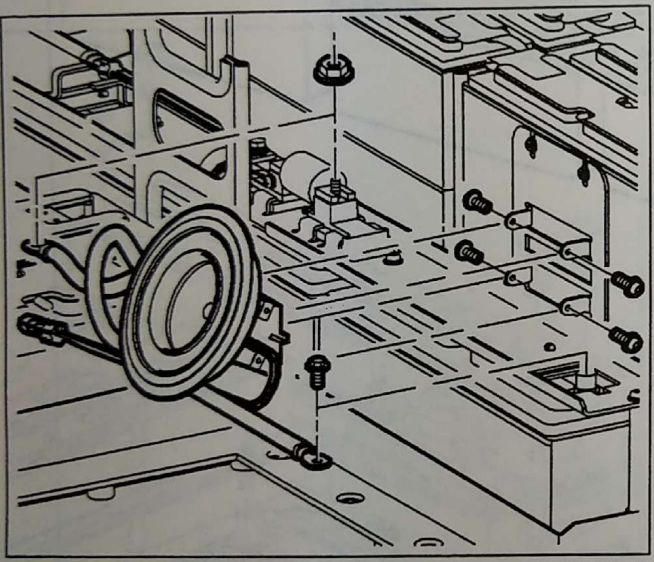


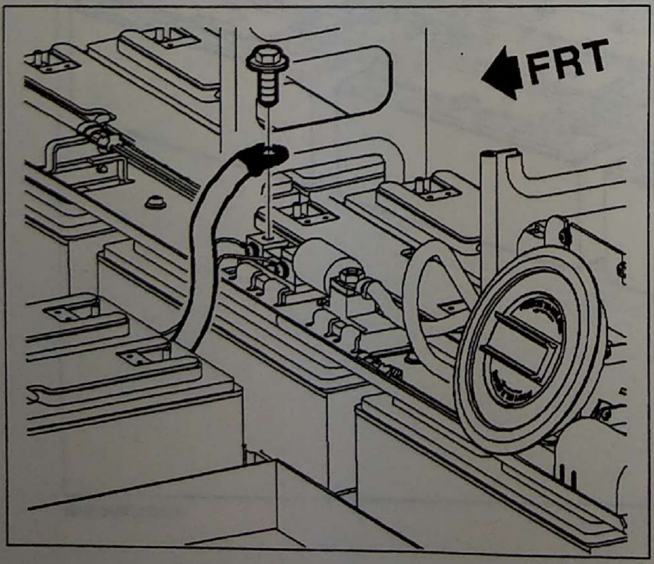
PSMELC68025AA

5. Remove the extension stud and shunt/fuse covers.



PSMELC67071AC

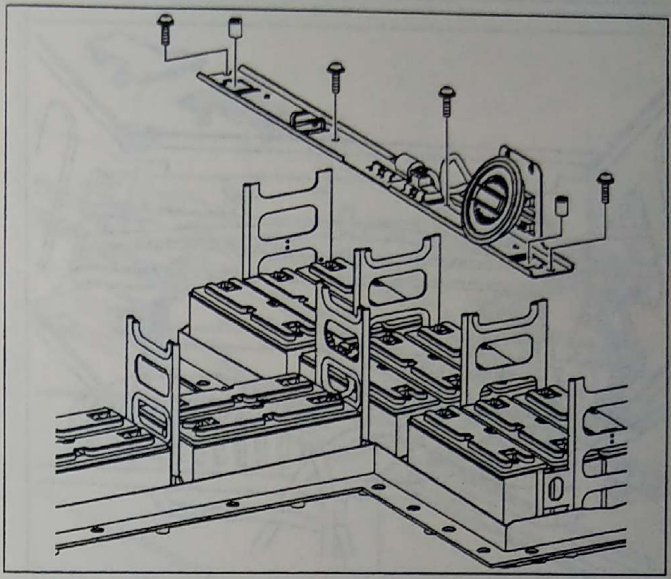
6. Disconnect the battery cable from the manual disconnect to the extension stud.
7. Disconnect the battery cable from the fuse and fully tape all exposed metal of the battery cable. Position the cable out of the way.
8. Disconnect the two–wire interlock loop connector going to the manual disconnect.



PSMELC68366AA

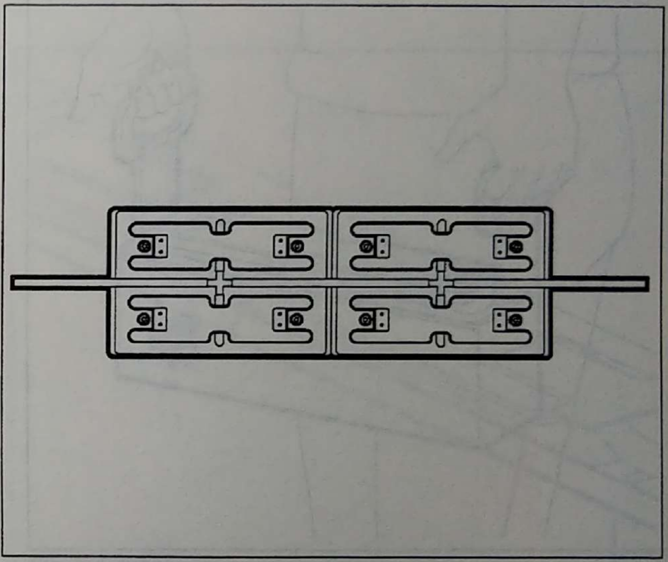
9. Disconnect and fully tape all exposed metal of the battery cable connected to the shunt.
10. Disconnect the two–wire shunt harness connector. Make note of the wire routing.
11. Disconnect and fully tape all exposed metal of the battery cable connected to the extension stud of battery module four. Make note of the cable routing and push the cable towards the front of the battery pack.

12. Disconnect the sense lead from battery module four. Make note of the wire routing.
13. Carefully remove extension studs with an insulated (tapped) tool.
14. Remove the bolts holding the cross bar to the battery pack. Carefully lift the cross bar up until it clears the modules and pull out from left side.



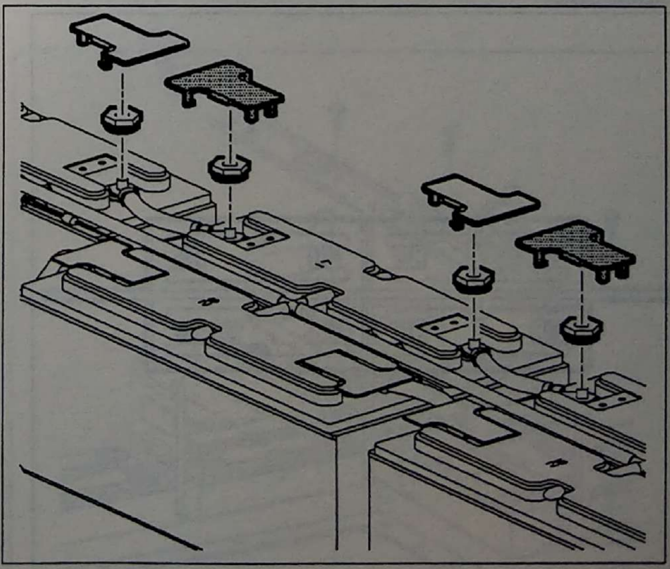
PSMPEN68426AA

15. Remove the vent tube connected to the battery module.



PSMELC68026AA

16. Remove the positive and negative terminal covers of the module.



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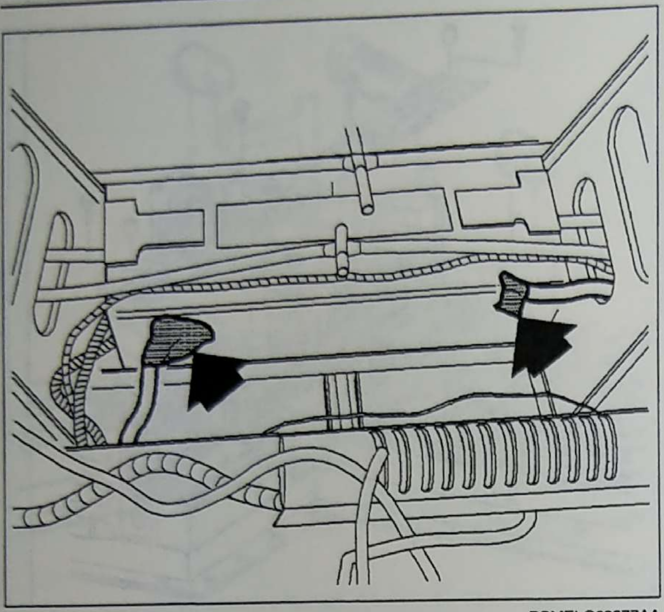
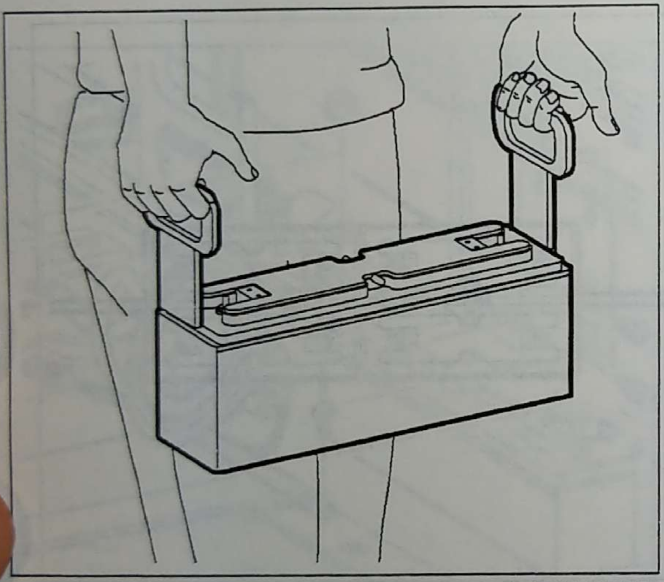


PSMELC68377AA

17. Remove the nuts holding the battery cables to the battery module. Lift each cable up and fully tape all exposed metal of the battery cable. Position the cable out of the way for module removal.

18. If removing modules 1, 3, 4, 6, 9 or 10, make sure the temperature sensor on the side of the module is disconnected.



PSMELC68378AA

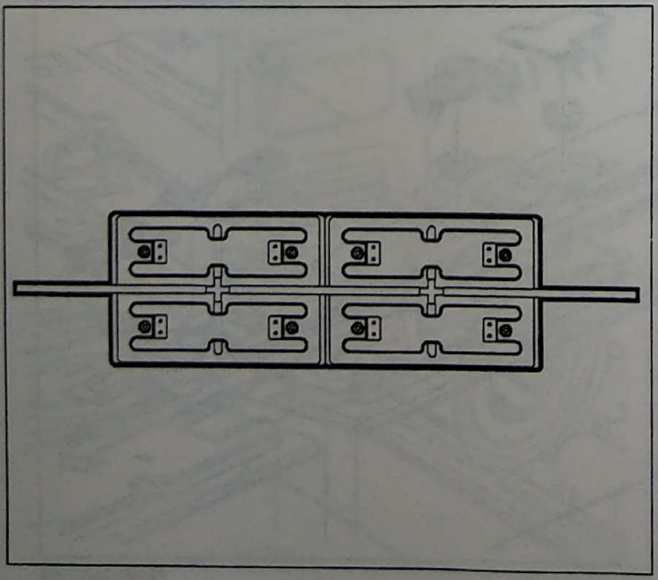
19. Connect the module removal tool EV9727E and remove the battery module.

INSTALLATION

1. Connect the module removal tool EV9727E and install the battery module. Move temperature sensor to new module.

IMPORTANT: Make sure the battery module is installed with the correct polarity (positive to negative).

2. Connect temperature sensor connector.



PSMELC68026AA

IMPORTANT: The sense lead wiring should be located under the vent tubing.

3. Install the vent tube to the battery module. Check the vent tube on the adjacent module for tightness.

4. Install the vent cap on the outside of the battery module.

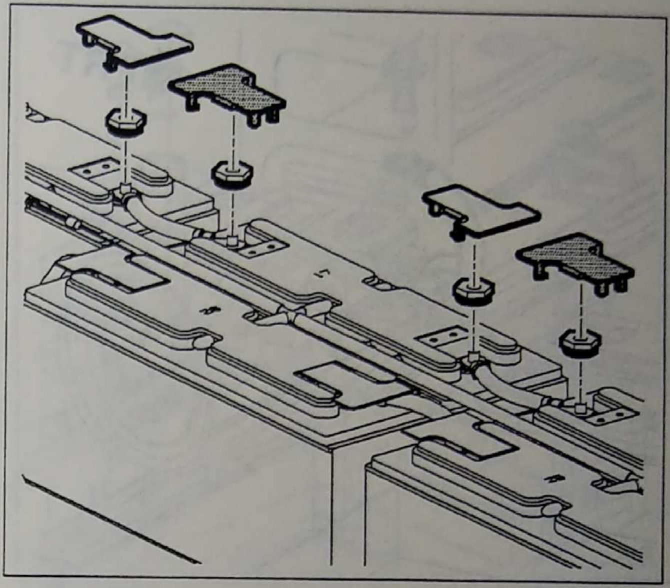
IMPORTANT: Make sure hex side of clincher nut is facing up.

NOTICE: Crimp side of cable should be facing up to prevent cable terminal from damaging battery module case.

5. Coat terminals with battery terminal coating. Install the battery cables one at a time, removing the tape and carefully placing the cable on the module. Tighten nuts.

Torque: 10 N•m (89 in-lbs)

6. Install the positive and negative terminal covers on the battery modules.
7. Inspect the vent tube harness for binding or pinching.

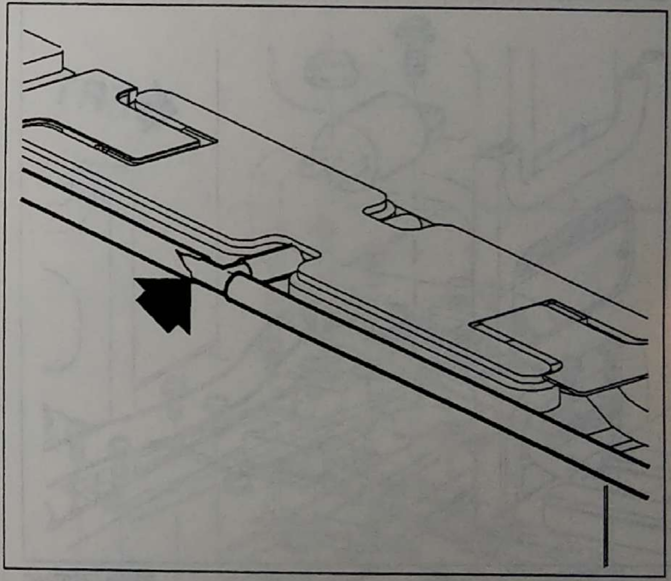


PSMELC67075AB

8. Carefully guide the cross bar into position and set in place. Install the cross bar to battery pack fasteners.

IMPORTANT: Before the cross bar is tightened down, make sure module four sense lead is routed through the cross bar.

Torque: 10 N•m (89 in-lbs)

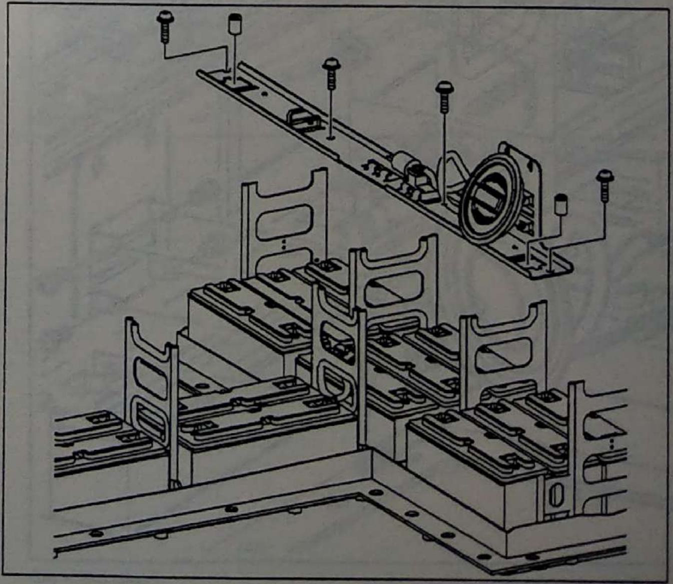


PSMELC68355AA

9. Coat terminals with battery terminal coating. Install the two extension studs and hand tighten until they bottom out and then turn 1/8 of a turn.
10. Route and connect the sense lead connector for module four.
11. Route and connect the battery cable to the extension stud of battery module #4.

Torque: 10 N•m (89 in-lbs)

12. Install the extension stud cover on module four.



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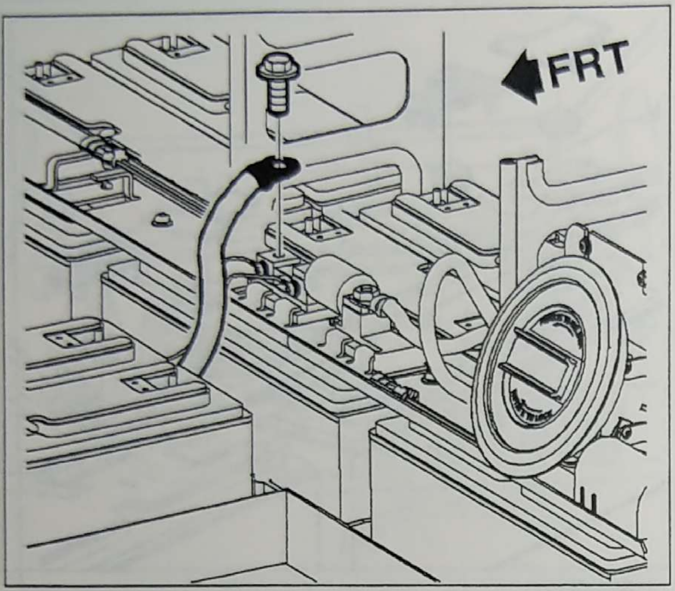


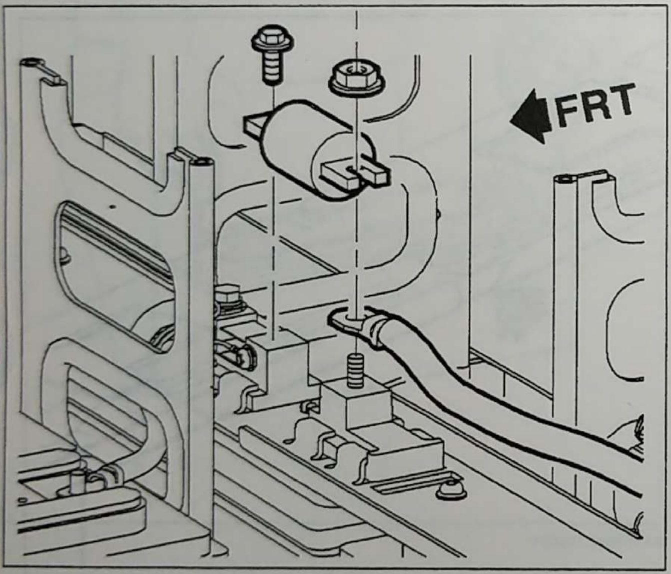
PSMELC68366AA

13. Route and connect the two–wire connector for the shunt harness.

14. Connect the battery cable to the shunt. Make sure when cable is tightened it points straight out from the shunt or the shunt/fuse cover will not go on.

Torque: 10 N•m (89 in-lbs)

15. Route and connect the two–wire interlock connector for the manual disconnect.



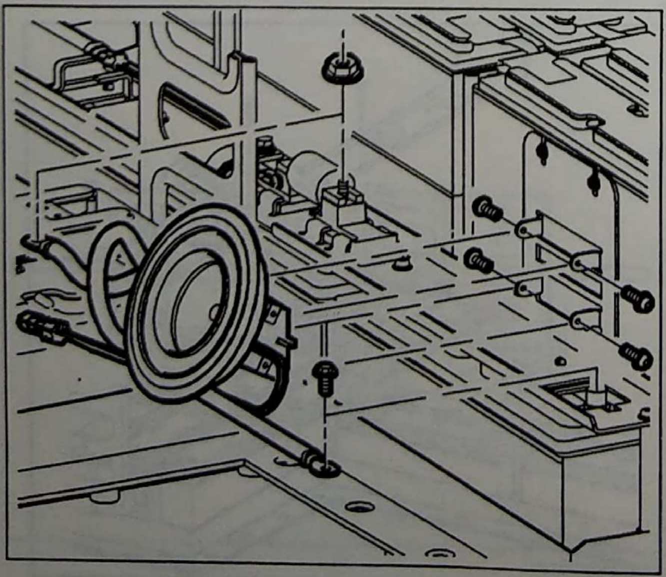
PSMELC67072AC

16. Connect the battery cable from the manual disconnect to the fuse. Make sure the cable points straight towards the manual disconnect or the shunt/fuse cover will not go on.

Torque: 10 N•m (89 in-lbs)

17. Install the shunt/fuse cover.

IMPORTANT: Make sure wiring does not get pinched when cover is installed.



PSMELC67071AC

18. Coat terminals with battery terminal coating. Connect the battery cable from the manual disconnect to the extension stud of module 12.

Torque: 10 N•m (89 in-lbs)

19. Install the extension stud cover for module 12.

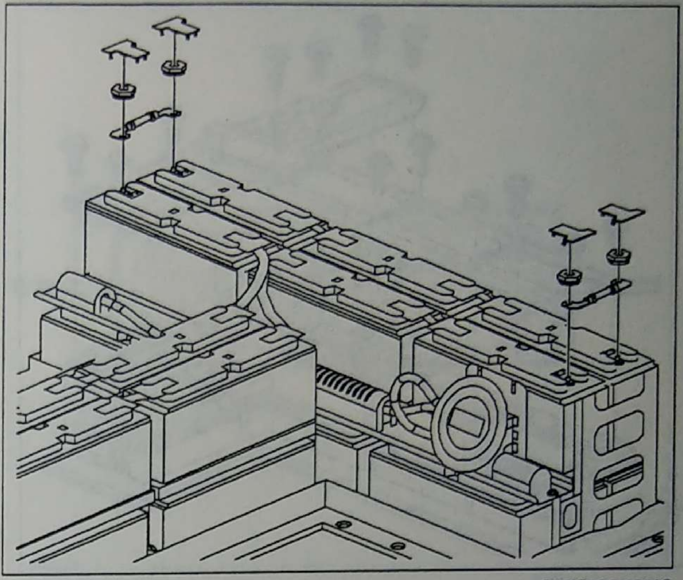
IMPORTANT: Make sure hex side of clincher nut is facing up.

NOTICE: Crimp side of cable should be facing up to prevent cable terminal from damaging battery module case.

20. Coat terminals with battery terminal coating. Install the battery interconnect cables connecting battery terminals at battery modules #19 – #20 and #22 – #23. Install terminal covers.

Torque: 10 N•m (89 in-lbs)

21. Visually inspect the pack for pinched/broken vent tubes, wiring, etc.



PSMELC67073AB

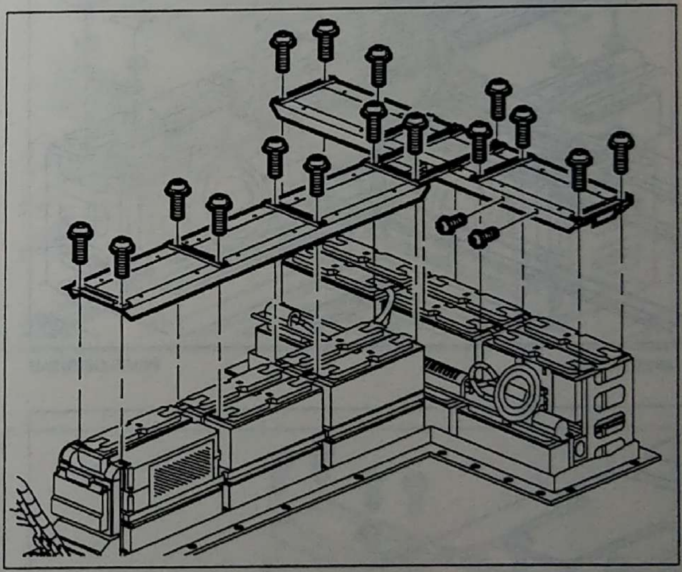
22. Perform the "Battery Pack" and "Vent Harness" system check procedures.

CAUTION: MAKE SURE WHEN INSTALLING THE TOP COVERS THAT THE VENT HARNESS DOES NOT GET PINCHED. PINCHING THE VENT HARNESS MAY CAUSE THE VENT SYSTEM TO FUNCTION INCORRECTLY.

23. Install the rear battery pack top cover.

Torque: 10 N•m (89 in-lbs)
(3 N•m [27 in-lbs] top cover to manual disconnect)

24. Install the battery pack. (Refer to "Battery Pack" installation procedure in this manual.)



PSMELC67066AB

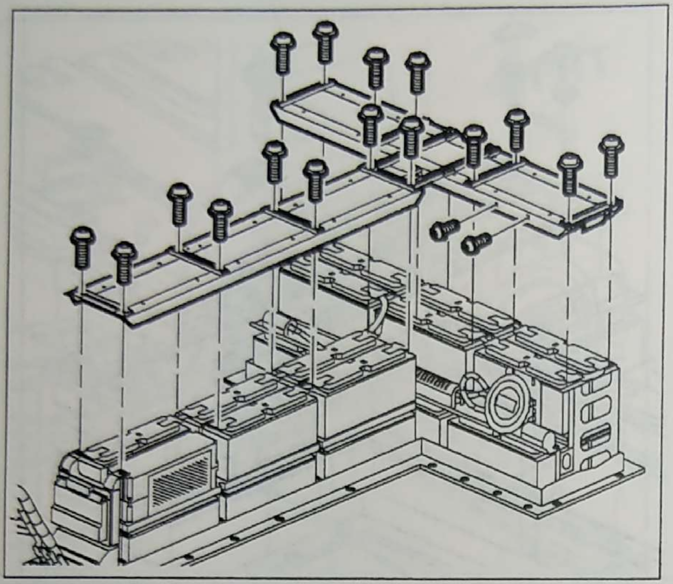
VENT TUBE

REMOVAL

1. Remove the battery pack from the vehicle. (Refer to "Battery Pack" removal in this manual.)

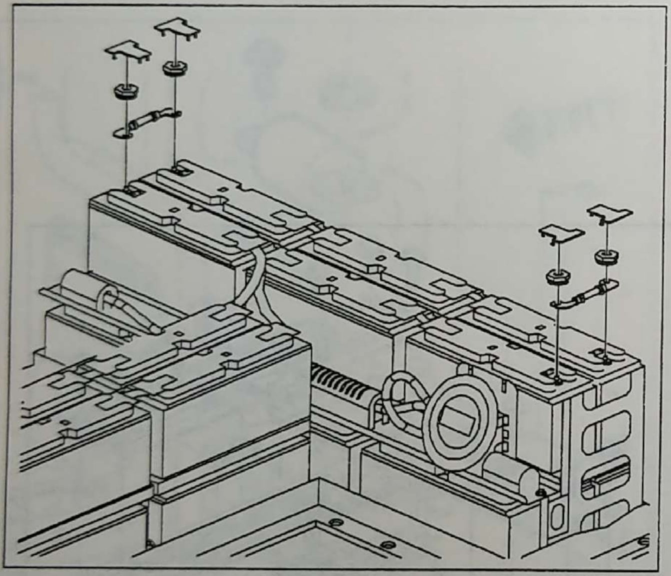
CAUTION: WITH THE BATTERY PACK OUT OF THE VEHICLE YOU ARE EXPOSED TO HIGH VOLTAGE. NEVER LEAN ON THE BATTERY PACK OR TOUCH THE BATTERY BACK WITH BOTH HANDS. FOLLOW ALL PROCEDURES STEP BY STEP.

2. Remove the top covers on the battery pack.



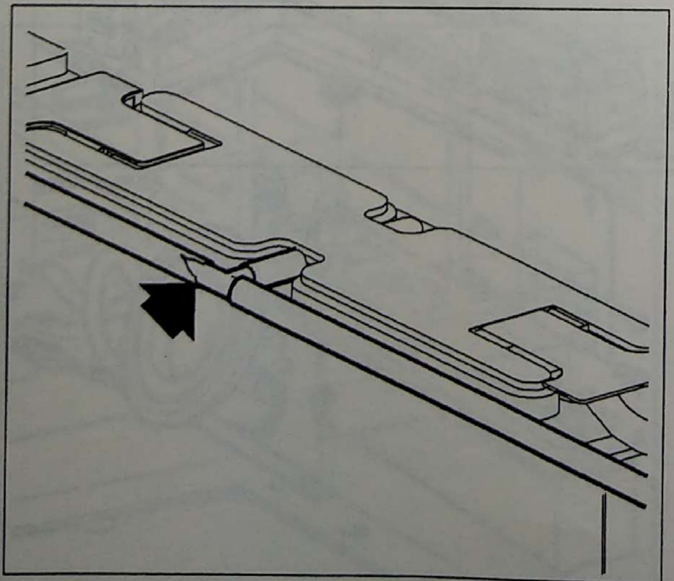
PSMELC67066AC

3. Remove the battery interconnect cables connecting battery terminals at battery module #19 – #20 and #22 – #23. This further breaks down the voltage potential of the battery pack.
4. Remove battery pack module (BPM).



PSMELC67073AB

5. Carefully inspect all vent harness and caps for damage.



PSMELC68355AA

6. Locate the section of vent tube required for replacement.

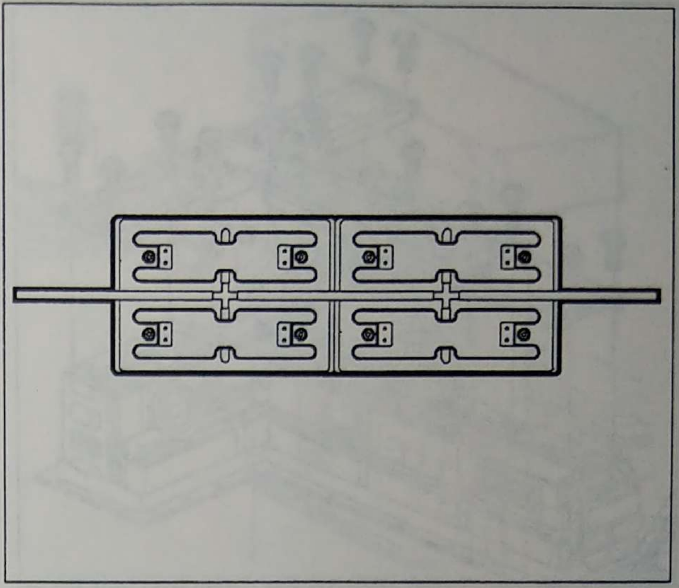
NOTICE: Refer to "Top Layer Battery Module" removal procedure when working with the lower vent harness.

7. Carefully remove the section of vent tube. Make sure none of the other vent tube connections were disturbed during removal.

INSTALLATION

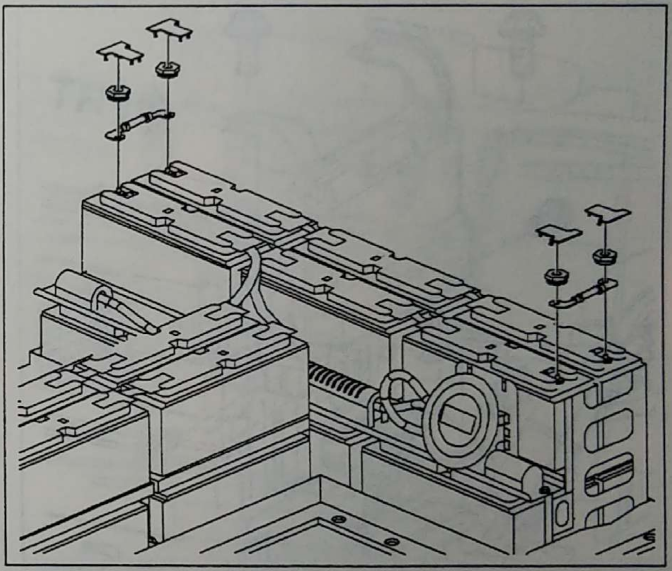
CAUTION: USE ONLY EV1 APPROVED VENT TUBE MATERIAL. OTHER VENT TUBE MATERIAL MAY BREAK DOWN CAUSING A SYSTEM LEAK.

1. Measure the removed section of vent tube and cut a new piece of vent tube to match.
2. Carefully install the new section of vent tube.



PSMELC68026AA

3. Install the battery interconnect cables connecting battery terminals at battery modules #19 – #20 and #22 – #23.
4. Visually inspect the pack for pinched/broken vent tubes, wiring etc.



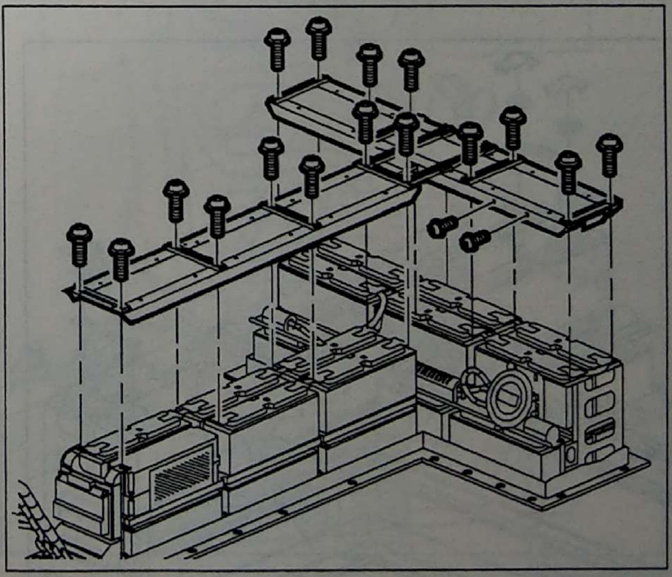
PSMELC67073AB

CAUTION: MAKE SURE WHEN INSTALLING THE TOP COVERS THAT THE VENT HARNESS DOES NOT GET PINCHED. PINCHING THE VENT HARNESS MAY CAUSE THE VENT SYSTEM TO FUNCTION INCORRECTLY.

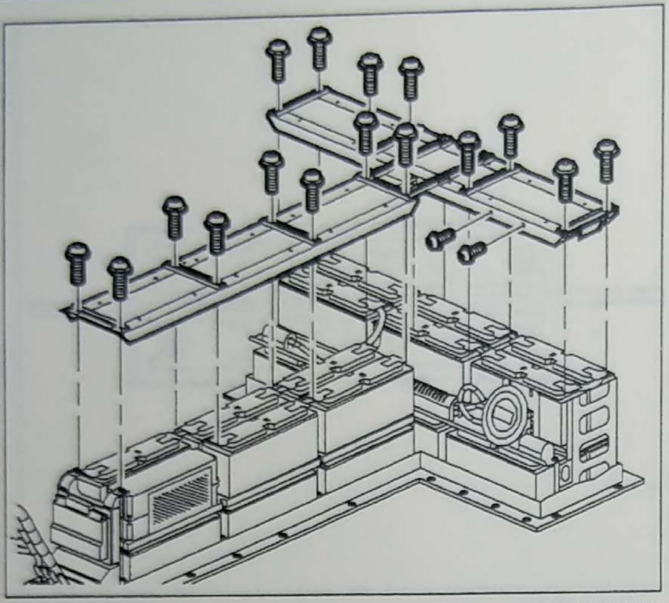
5. Install the battery pack top covers.

Torque: 10 N•m (89 in-lbs)
(3 N•m [27 in-lb] pack top to manual disconnect)

6. Perform the "Battery Pack" and "Vent Harness" system check procedures.
7. Install the battery pack. (Refer to "Battery Pack" installation procedure in this manual.)



PSMELC67066AC


PSMELC67066AC

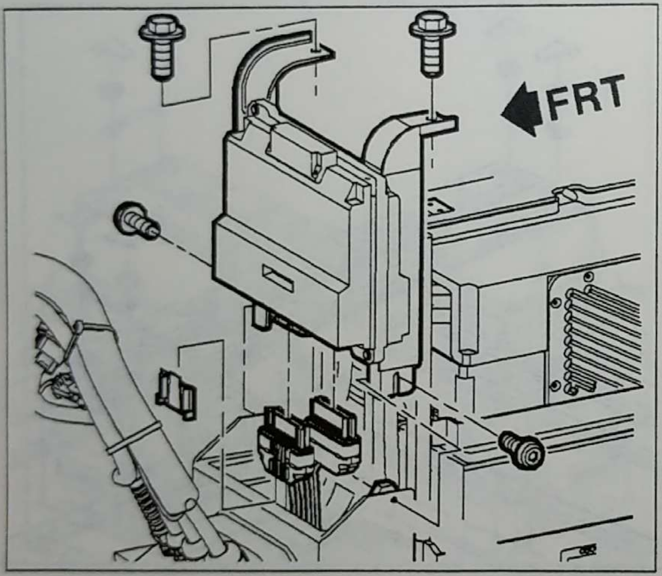
POSITIVE AND NEGATIVE CABLE ASSEMBLY WITH WIRING HARNESS (NOSE CONE HARNESS)

REMOVAL

1. Remove the battery pack from the vehicle. (Refer to "Battery Pack" removal in this manual.)

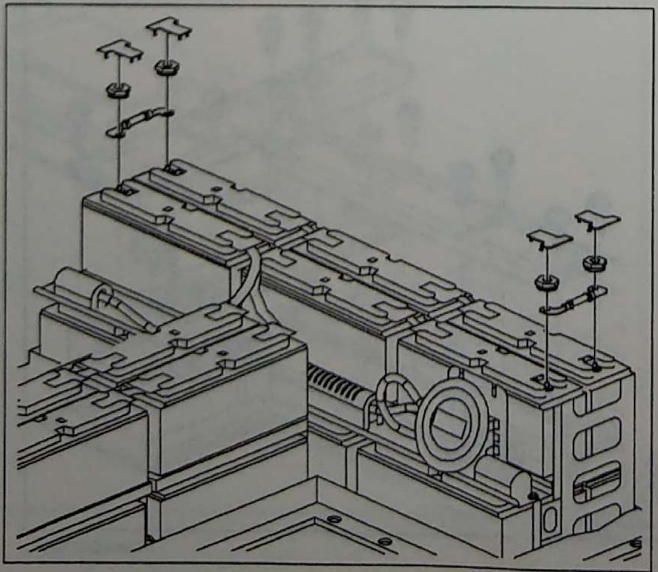
CAUTION: WITH THE BATTERY PACK OUT OF THE VEHICLE YOU ARE EXPOSED TO HIGH VOLTAGE. NEVER LEAN ON THE BATTERY PACK OR TOUCH THE BATTERY BACK WITH BOTH HANDS. FOLLOW ALL PROCEDURES STEP BY STEP.

2. Remove the top covers on the battery pack.



PSMELC67067AC

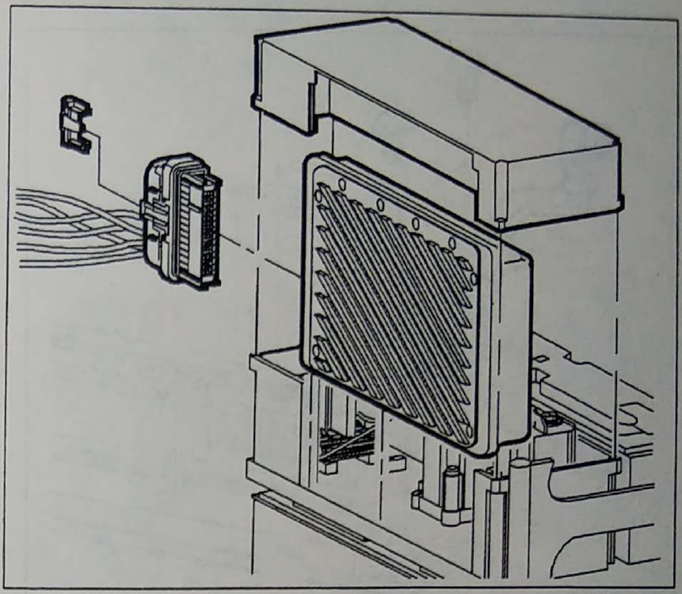
3. Remove battery pack module (BPM) and bracket assembly.
4. Remove BPM connectors.


PSMELC67073AB

5. Remove the battery interconnect cables connecting battery terminals at battery module #19 – #20 and #22 – #23. This further breaks down the voltage potential of the battery pack.

6. Remove the top cover to the auto disconnect (AD) system located in the front, top, left corner of the battery pack.

CAUTION: TO PREVENT ARC AND/OR SHOCK, DO NOT SHORT ACROSS THE TWO RELAYS IN THE AUTO DISCONNECT SYSTEM.

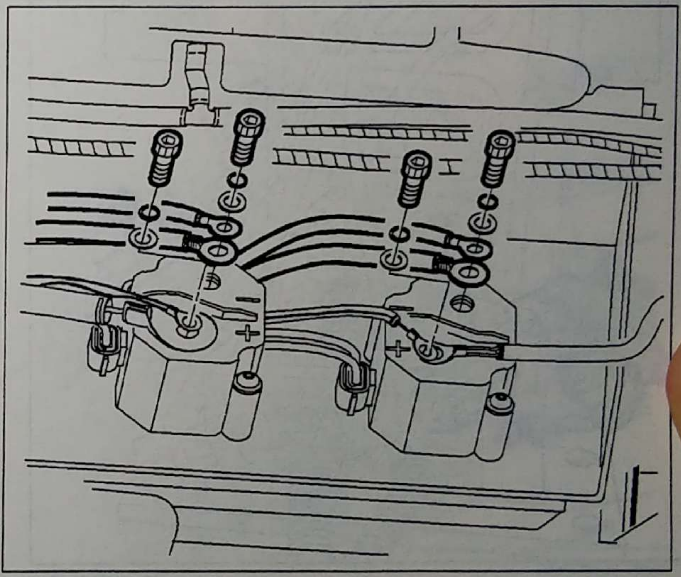


PSMELC67070AC

7. Remove the high voltage cables from the harness side to the relays (orange cables). Leave the module side cables to the relay connected. Take note of high voltage wire location.

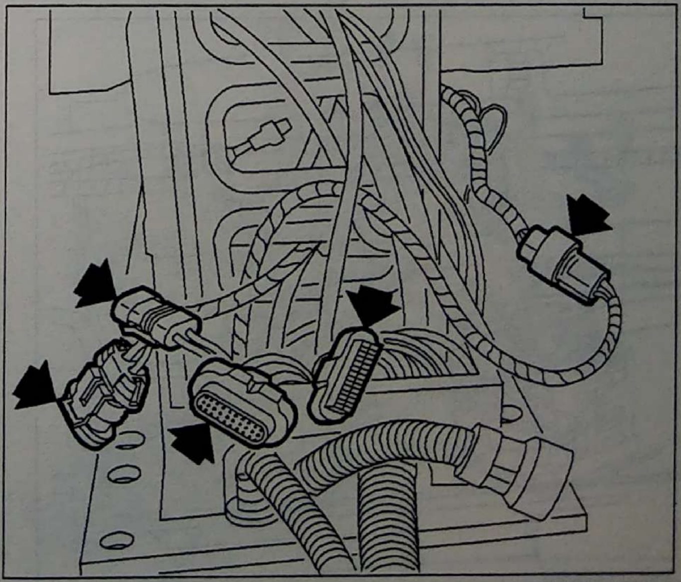
NOTICE: Mark the rear most cable and relay with paint pen to properly identify components for reassembly. Incorrect assembly will result in serious battery pack damage.

8. Carefully pull the high voltage cables to the front of the battery pack.

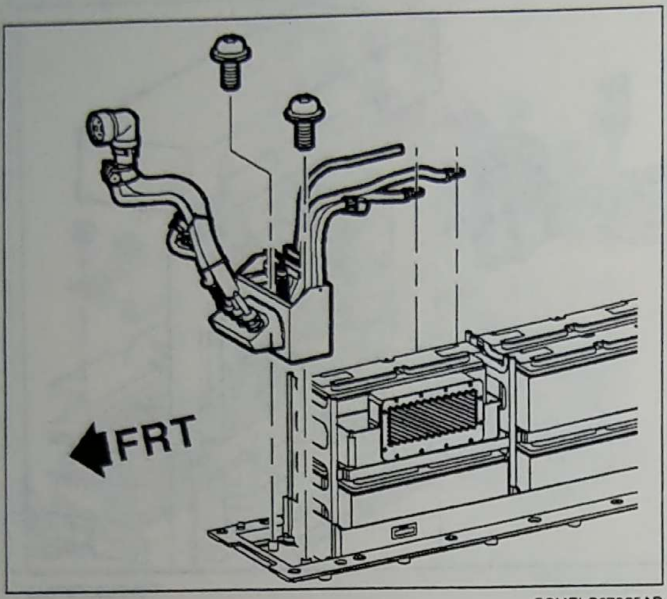


PSMELC67060AB

9. Disconnect the five connectors at the front of the battery pack.
10. Disconnect the harness vent tube from vent "T" at #16 module.



PSMELC67069AA



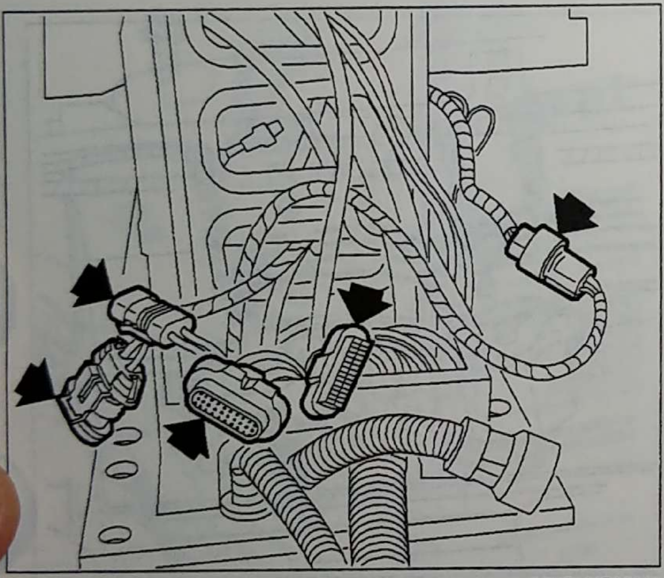
PSMELC67065AB

11. Remove the two lower bolts at the base of the nose cone housing.
12. Carefully lift the positive and negative cable assembly with wiring harness (nose cone wiring housing) from the battery pack.

INSTALLATION

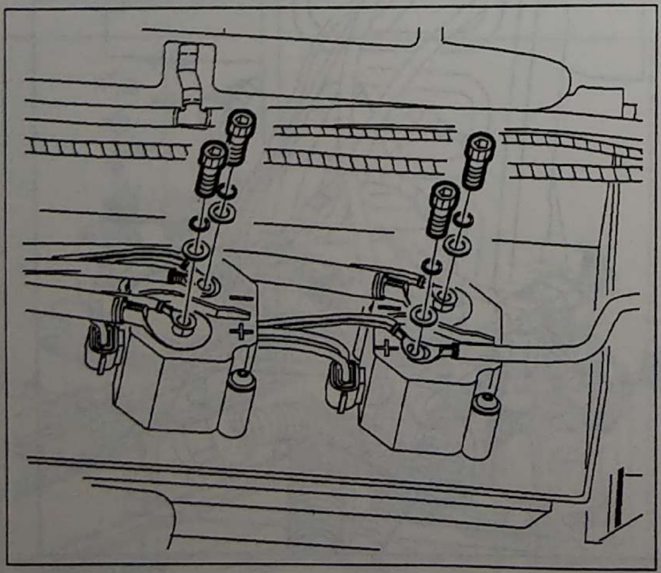
1. Lower the nose cone wiring housing into place in the battery pack.
2. Install the two bolts at the base of the nose cone wiring housing.

Torque: **3 N•m (27 in-lbs)**



PSMELC67069AA

3. Connect the five wiring harness connectors at the front of the pack
4. Install the vent tube to module #16 at the vent "T."
5. Route the high voltage cables to the auto disconnect high voltage relays.



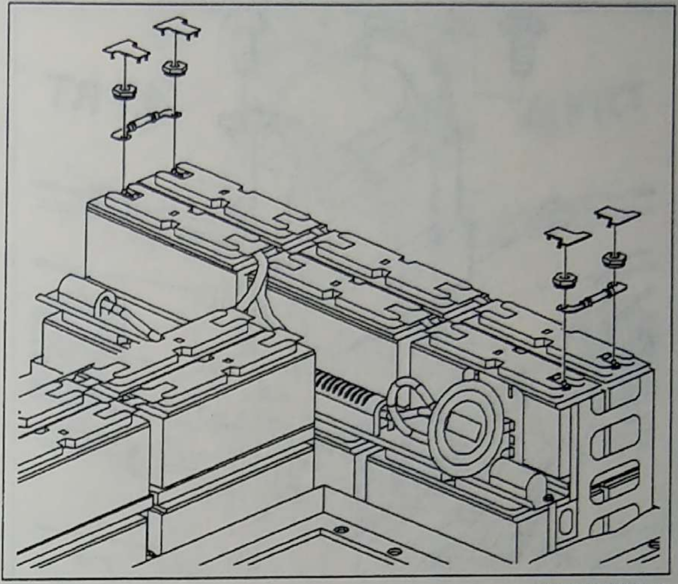
PSMELC67060AA

6. Install the two high voltage cables on the relays. Make sure they are routed to the correct relay.

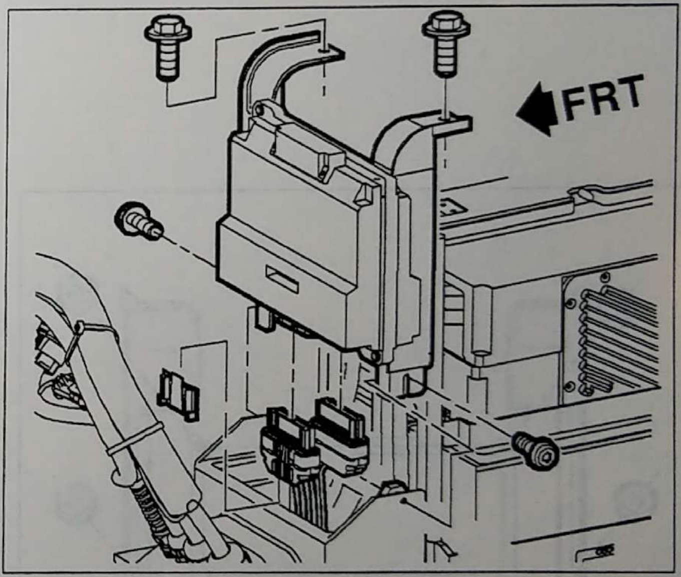
NOTICE: Be sure to install cables to the proper relay. Incorrectly installed high voltage cables will result in serious battery pack damage.

7. Install the AD system top cover. Make sure wiring does not get pinched by the AD top cover.

8. Install the battery interconnect cables connecting battery terminals at battery modules #19 – #20 and #22 – #23.
9. Visually inspect the pack for pinched/broken vent tubes, wiring etc.


PSMELC67073AB

10. Install connectors on BPM.
11. Install connector-positive assurance (CPA).
12. Install BPM to the BP.



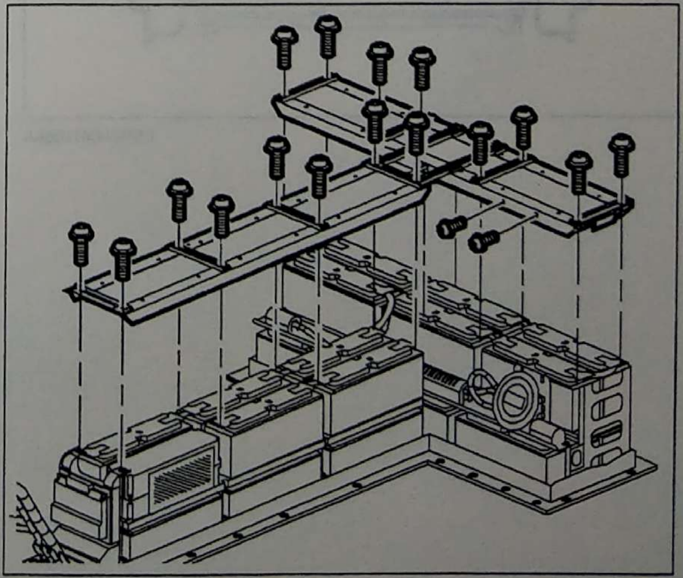
PSMELC67067AC

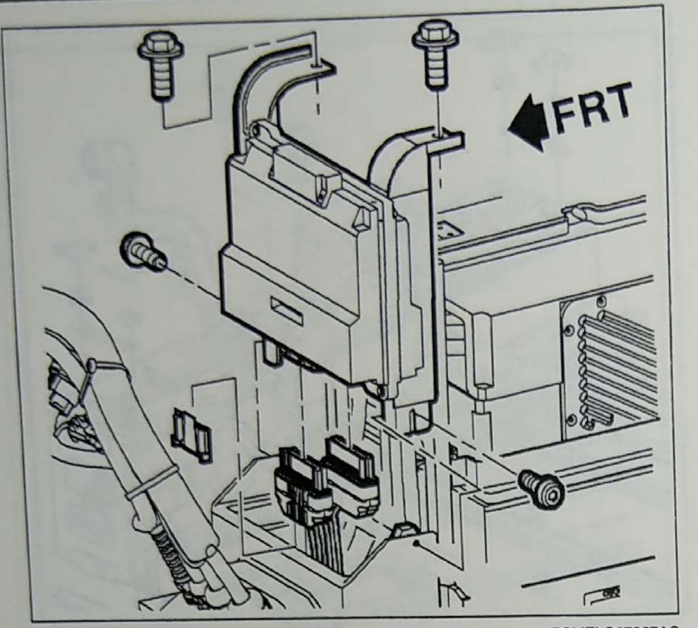
CAUTION: MAKE SURE WHEN INSTALLING THE TOP COVERS THAT THE VENT HARNESS DOES NOT GET PINCHED. PINCHING THE VENT HARNESS MAY CAUSE THE VENT SYSTEM TO FUNCTION INCORRECTLY.

13. Install the battery pack top covers.

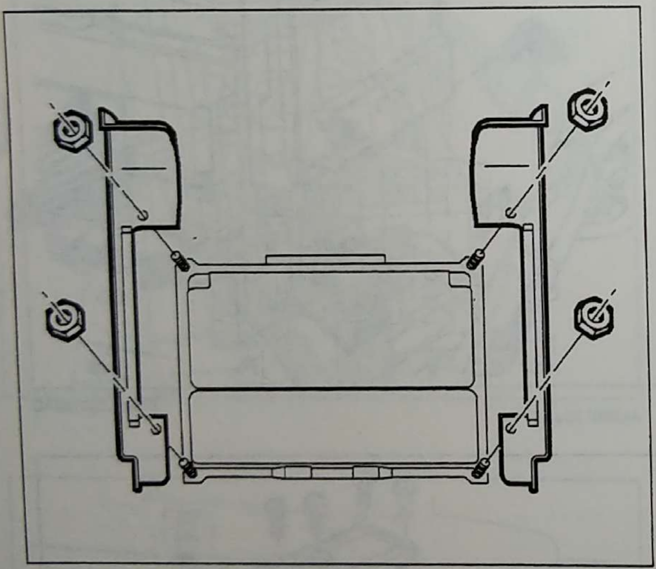
Torque: 10 N•m (89 in-lbs)
(3 N•m [27 in-lb] pack top to manual disconnect)

14. Perform the “Battery Pack” and “Vent Harness” system check procedures.
15. Install the battery pack. (Refer to “Battery Pack” installation procedure in this manual.)


PSMELC67066AC



PSMELC67067AC



PSMELC67068AA

DRIVE MOTOR BATTERY PACK CONTROL MODULE (BPM)

REMOVAL

1. Remove the battery pack from the vehicle. (Refer to "Battery Pack" removal in this manual.)

CAUTION: WITH THE BATTERY PACK OUT OF THE VEHICLE YOU ARE EXPOSED TO HIGH VOLTAGE. NEVER LEAN ON THE BATTERY PACK OR TOUCH THE BATTERY BACK WITH BOTH HANDS. FOLLOW ALL PROCEDURES STEP BY STEP.

2. The battery pack module (BPM) is located in the front of the battery pack just behind the high voltage (HV) wiring harness that attaches to the vehicle.
3. Remove the two upper BPM brackets to battery pack (BP) bolts.
4. Loosen the two lower bracket bolts. The bracket is slotted on the bottom .
5. Lift BPM enough to remove connector-positive assurance (CPAs) and disconnect the two 32-way connectors.
6. Remove BPM and bracket assembly.

IMPORTANT: Do not remove the bolts that connect the BPM case to the bracket. These bolts not only hold the case to the bracket but they hold the two BPM case halves together.

7. Turn the BPM and bracket assembly over and remove the nuts holding the bracket assembles on to the BPM.

INSTALLATION

1. Install the two BPM brackets on the back side of the BPM using the nuts.

Torque: **2 N•m (18 in-lbs)**

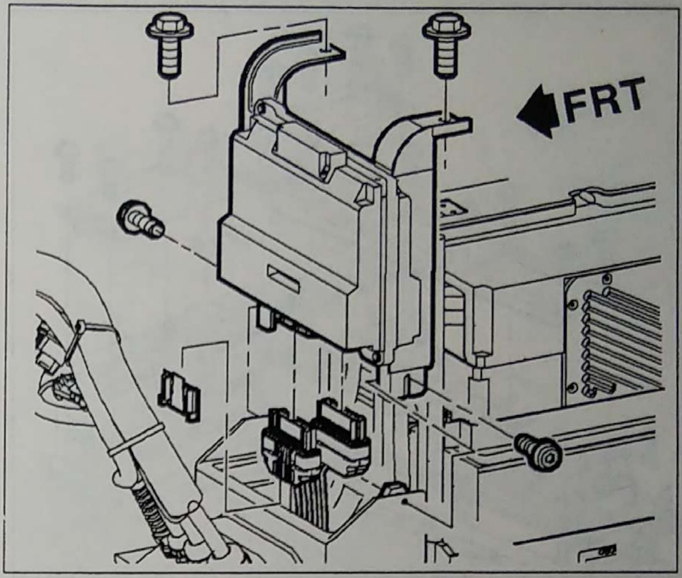
2. Connect the two 32-way BPM connectors and install CPA.
3. Install the BPM bracket assembly to the battery pack and tighten lower screws.

Torque: 3 N•m (27 in-lbs)

4. Install the two upper BPM bracket bolts.

Torque: 10 N•m (89 in-lbs)

5. Install the battery pack. (Refer to "Battery Pack" installation procedure in this manual.)



PSMELC67067AC

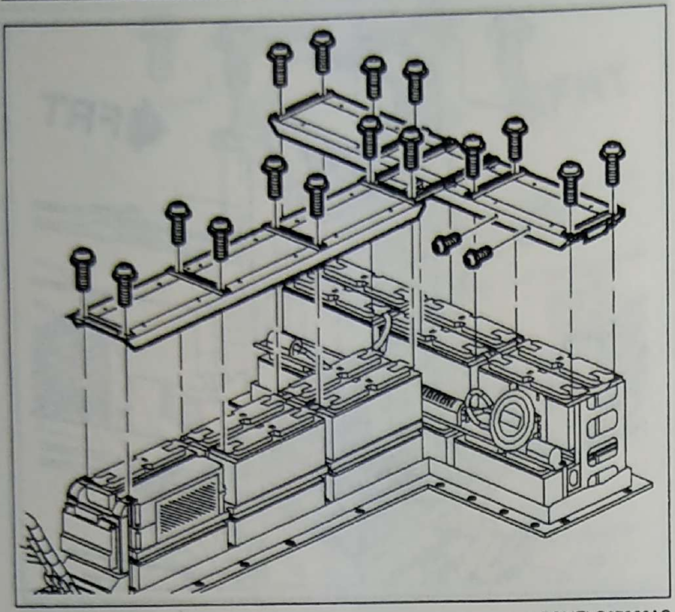
FUSE

REMOVAL

1. Remove the battery pack from the vehicle. (Refer to "Battery Pack" removal in this manual.)

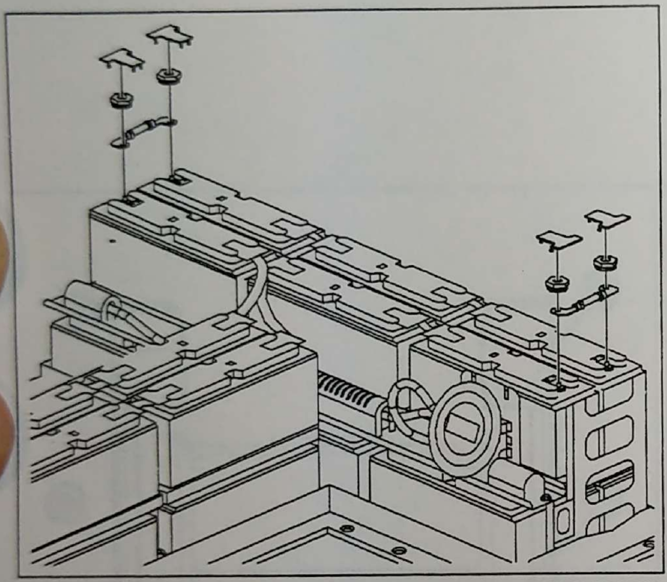
CAUTION: WITH THE BATTERY PACK OUT OF THE VEHICLE YOU ARE EXPOSED TO HIGH VOLTAGE. NEVER LEAN ON THE BATTERY PACK OR TOUCH THE BATTERY BACK WITH BOTH HANDS. FOLLOW ALL PROCEDURES STEP BY STEP.

2. Remove the top covers on the battery pack.



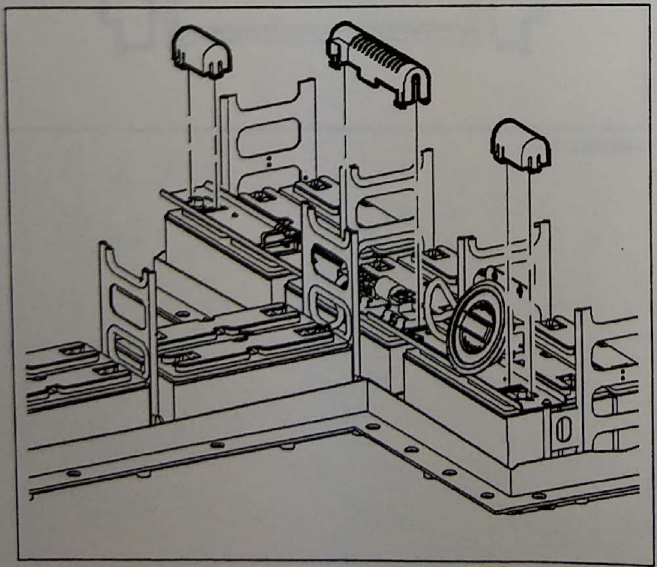
PSMELC67066AC

3. Remove the battery interconnect cables connecting battery terminals at battery module #19 – #20 and #22 – #23. This further breaks down the voltage potential of the battery pack.



PSMELC67073AB

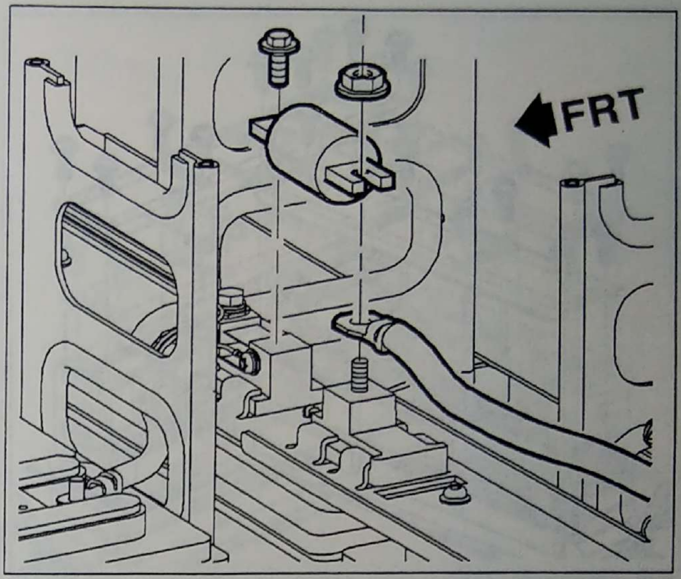
4. Locate the fuse at the base of the cross portion of the "T." Remove the shunt and fuse cover.



PSMELC68025AA

CS CamScanner

5. Remove bolt and nut at each end of fuse and tape cable from manual disconnect. The wire does have a voltage potential.



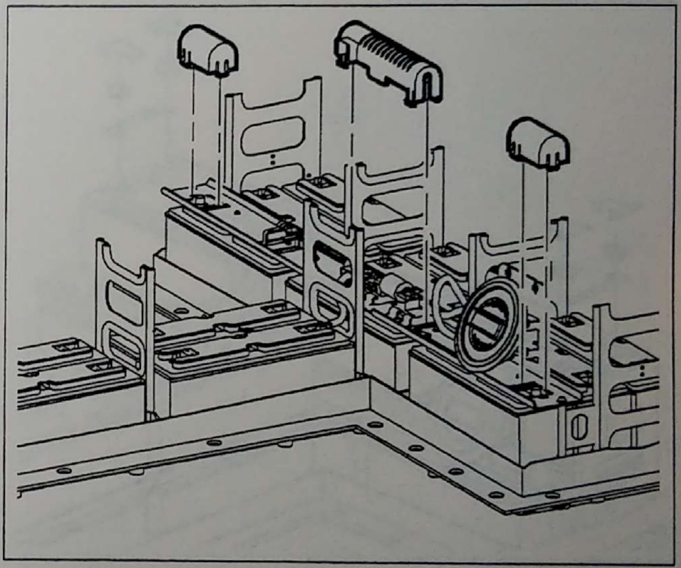
PSMELC67072AC

INSTALLATION

1. Place the fuse in position on the cross bar.
2. Install bolt on shunt side of fuse.
3. Remove tape from cable, install on fuse block, and secure with nut.
4. Tighten both fuse bolt and nut.

Torque: **10 N•m (89 in-lbs)**

5. Replace the shunt/fuse cover.

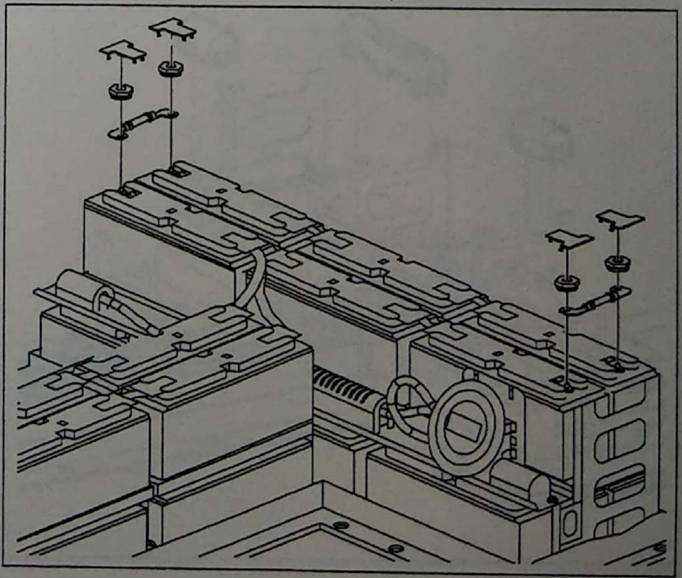


PSMELC68025AA

6. Install the battery interconnect cables connecting battery terminals at battery modules #19 – #20 and #22 – #23.

Torque: **10 N•m (89 in-lbs)**

7. Visually inspect the pack for pinched/broken vent tubes, wiring etc.



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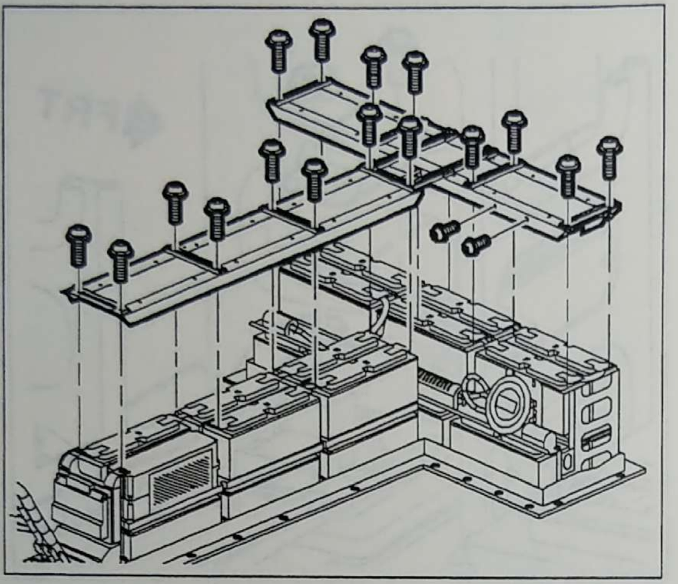


PSMELC67066AC

CAUTION: MAKE SURE WHEN INSTALLING THE TOP COVERS THAT THE VENT HARNESS DOES NOT GET PINCHED. PINCHING THE VENT HARNESS MAY CAUSE THE VENT SYSTEM TO FUNCTION INCORRECTLY.

8. Install the battery pack top covers.

Torque: 10 N•m (89 in-lbs)
(3 N•m [27 in-lb] pack top to manual disconnect)

9. Install the battery pack. (Refer to "Battery Pack" installation procedure in this manual.)

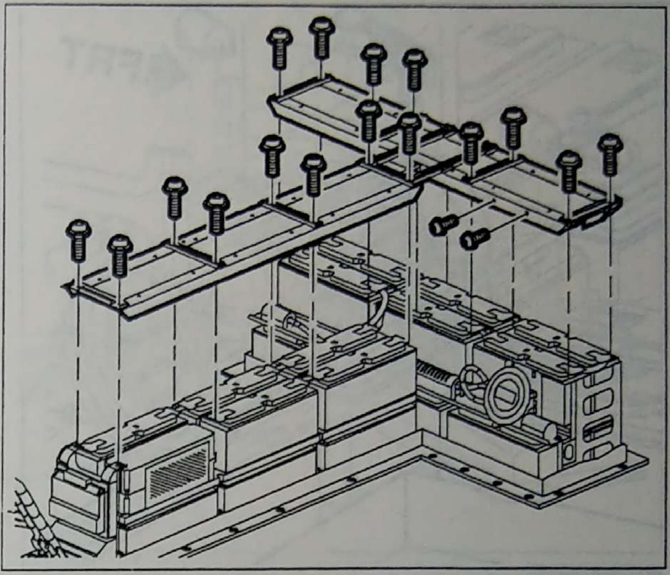
SHUNT

REMOVAL

1. Remove the battery pack from the vehicle. (Refer to "Battery Pack" removal in this manual.)

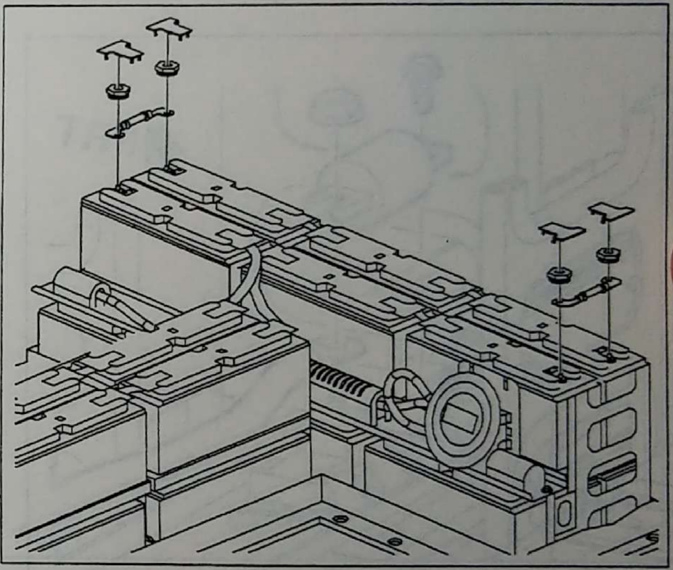
CAUTION: WITH THE BATTERY PACK OUT OF THE VEHICLE YOU ARE EXPOSED TO HIGH VOLTAGE AND CURRENT. NEVER LEAN ON THE BATTERY PACK OR TOUCH THE BATTERY BACK WITH BOTH HANDS. FOLLOW ALL PROCEDURES STEP BY STEP.

2. Remove the rear top cover on the battery pack.



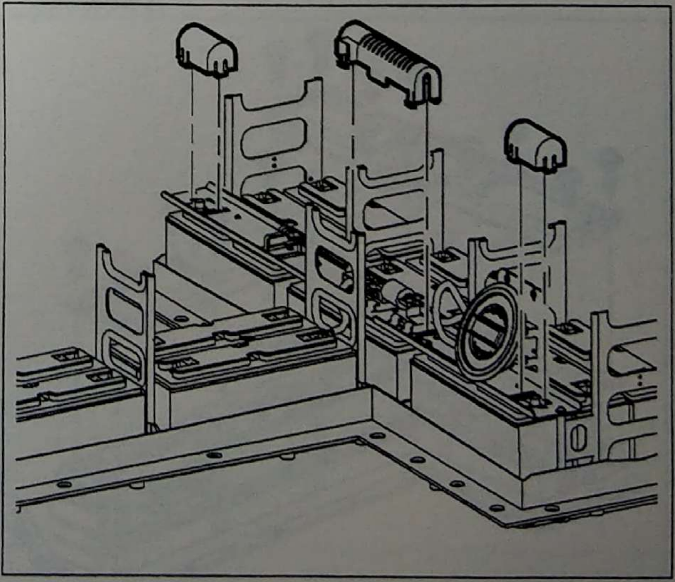
PSMELC67066AC

3. Remove the battery interconnect cables connecting battery terminals at battery module #19 – #20 and #22 – #23. This further breaks down the voltage potential of the battery pack.

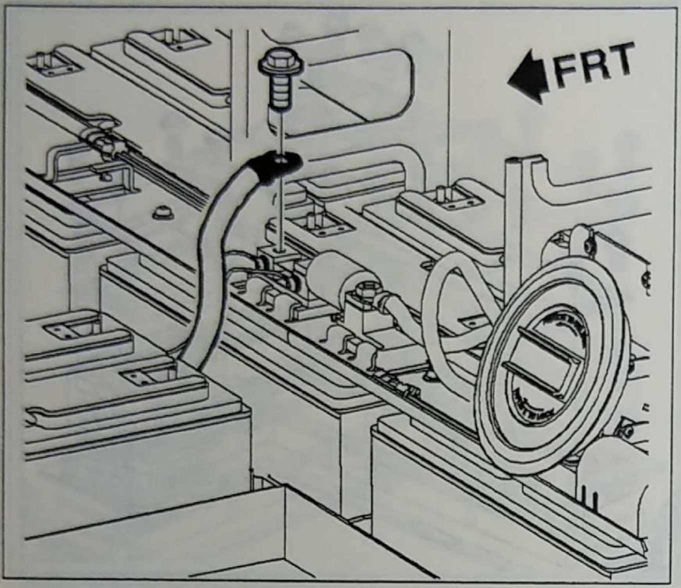


PSMELC67073AB

4. Locate the shunt at the base of the cross portion of the "T." Remove the shunt and fuse cover.

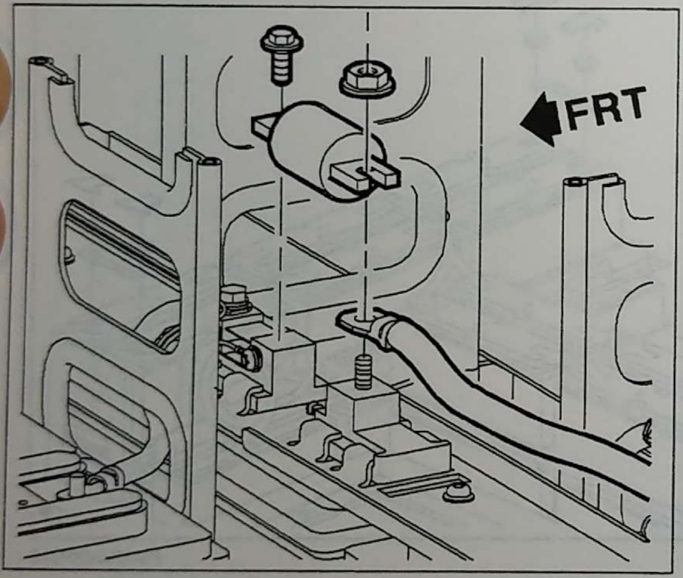


PSMELC68025AA



PSMELC68366AA

5. Remove the wire from the passenger side of the shunt and tape the wire so it will not make contact with anything (opposite fuse).
6. Disconnect two–wire shunt sense connector.



PSMELC67072AC

7. Remove bolt and nut at each end of fuse and tape cable from manual disconnect.
8. Slide shunt away from manual disconnect.
9. Remove sense leads on either side of shunt.

INSTALLATION

1. Install sense leads to the shunt bar.

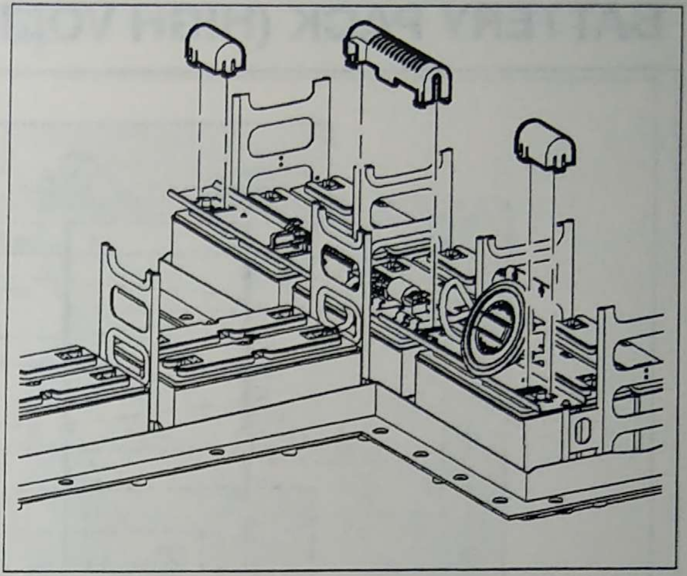
NOTICE: White sense lead must be installed closest to manual disconnect. Black sense lead installed toward passenger side of battery pack

Torque: 1 N•m (1 in-lbs)

2. Place the shunt in position on the cross bar and slide toward manual disconnect.
3. Place fuse into position between shunt and fuse block.
4. Remove the tape from cable going to manual disconnect. Install cable on fuse block.
5. Connect shunt to wire connector.
6. Remove the tape from the cable going to the shunt and connect to the shunt.
7. Install and tighten shunt/fuse bolts and fuse nut.

Torque: 10 N•m (89 in-lbs)

8. Replace the shunt/fuse cover.

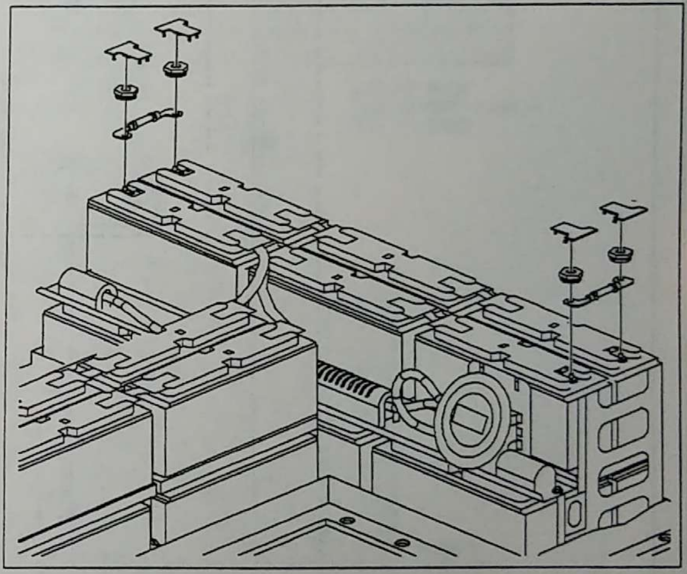


PSMELC68025AA

9. Install the battery interconnect cables connecting battery terminals at battery modules #19 – #20 and #22 – #23.

Torque: 10 N•m (89 in-lbs)

10. Visually inspect the pack for pinched/broken vent tubes, wiring etc.



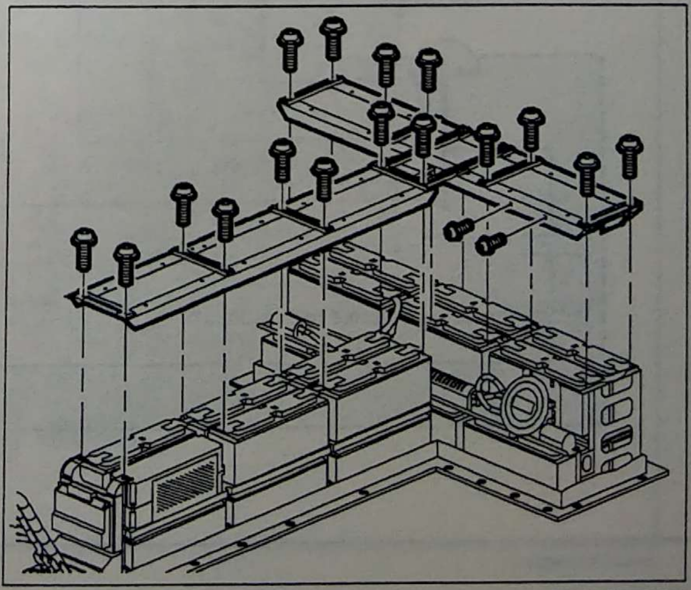
PSMELC67073AB

CAUTION: MAKE SURE WHEN INSTALLING THE TOP COVERS THAT THE VENT HARNESS DOES NOT GET PINCHED. PINCHING THE VENT HARNESS MAY CAUSE THE VENT SYSTEM TO FUNCTION INCORRECTLY.

11. Install the battery pack top covers.

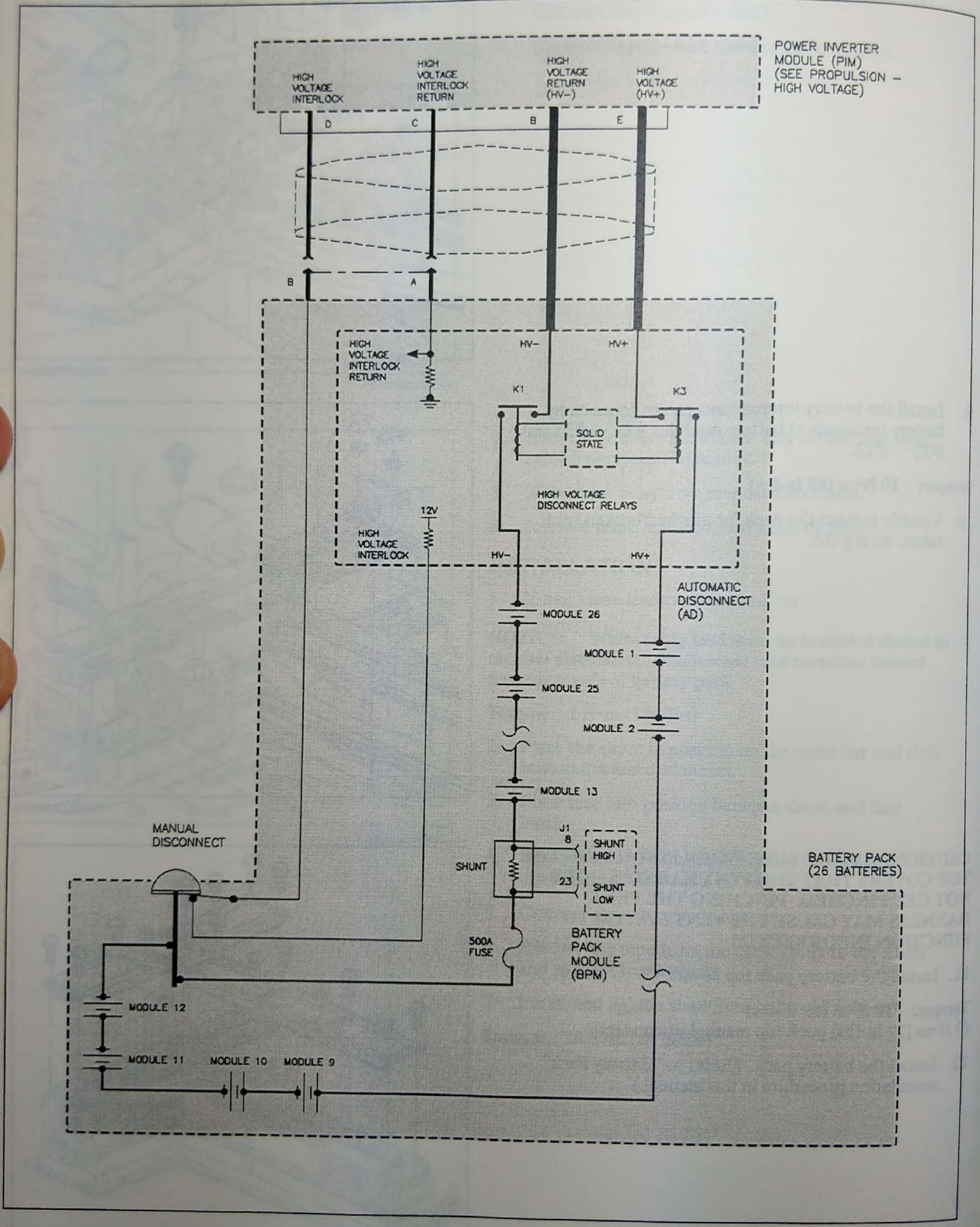
Torque: 10 N•m (89 in-lbs)
(3 N•m [27 in-lbs] pack top manual disconnect)

12. Install the battery pack. (Refer to "Battery Pack" installation procedure in this manual.)



PSMELC67066AC

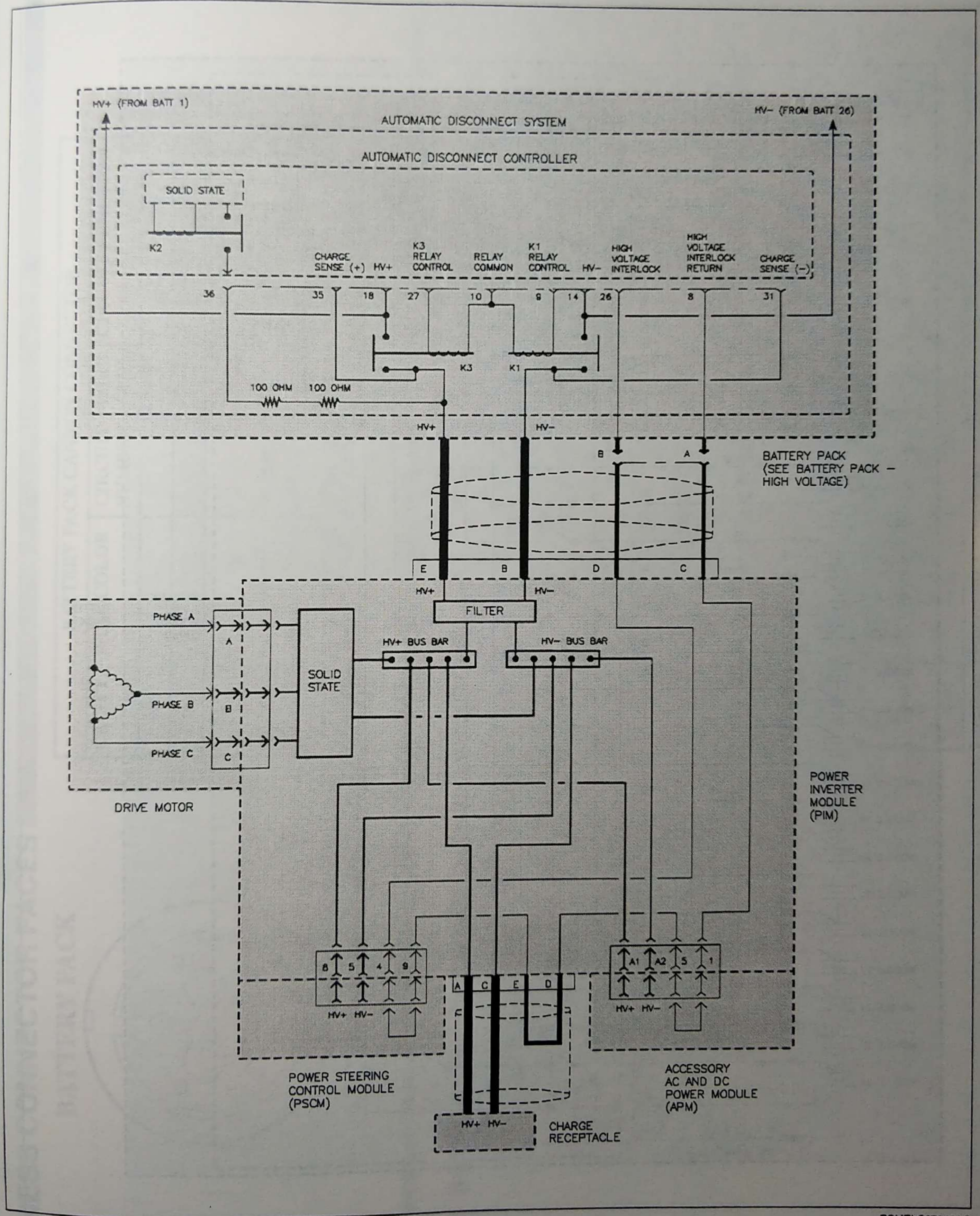
BATTERY PACK (HIGH VOLTAGE)


POWER INVERTER MODULE (PIM) (SEE PROPULSION – HIGH VOLTAGE)
HIGH VOLTAGE INTERLOCK
HIGH VOLTAGE INTERLOCK RETURN
HIGH VOLTAGE RETURN (HV–)
HIGH VOLTAGE (HV+)
D
C
B
E
B
A
HIGH VOLTAGE INTERLOCK RETURN
HV–
HV+
K1
K3
SOLID STATE
HIGH VOLTAGE DISCONNECT RELAYS
12V
HIGH VOLTAGE INTERLOCK
HV–
HV+
AUTOMATIC DISCONNECT (AD)
MODULE 26
MODULE 1
MODULE 25
MODULE 2
MODULE 13
J1
8
23
SHUNT HIGH
SHUNT LOW
SHUNT
MANUAL DISCONNECT
BATTERY PACK (26 BATTERIES)
500A FUSE
BATTERY PACK MODULE (BPM)
MODULE 12
MODULE 11
MODULE 10
MODULE 9

PSMELC68116AA

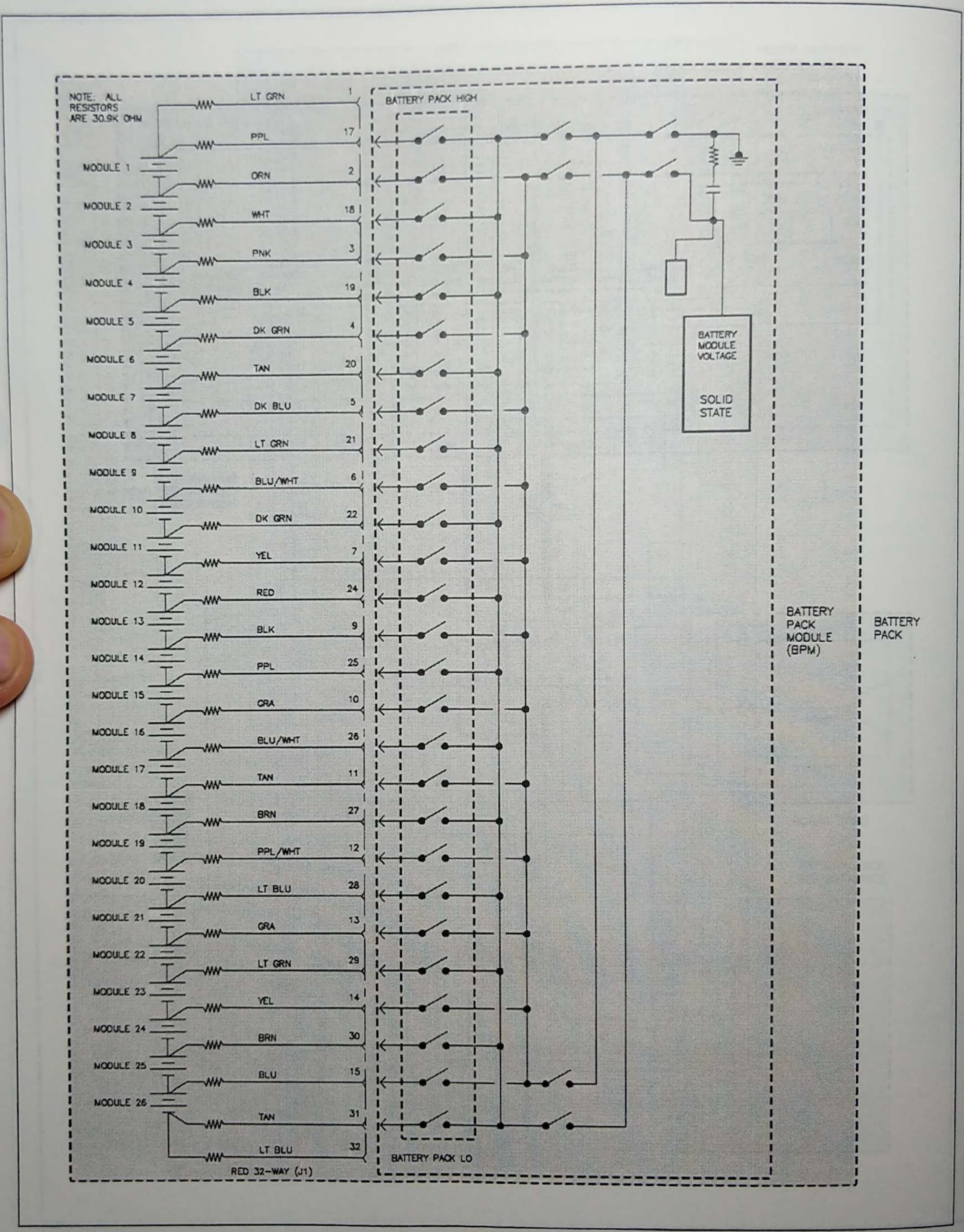
CS CamScanner

BATTERY PACK (LOW VOLTAGE)


HV+ (FROM BATT 1)
AUTOMATIC DISCONNECT SYSTEM
HV– (FROM BATT 26)
AUTOMATIC DISCONNECT CONTROLLER
SOLID STATE
K2
CHARGE SENSE (+)
HV+
K3 RELAY CONTROL
RELAY COMMON
K1 RELAY CONTROL
HV–
HIGH VOLTAGE INTERLOCK
HIGH VOLTAGE INTERLOCK RETURN
CHARGE SENSE (–)
36
35
18
27
10
9
14
26
8
31
K3
K1
100 OHM
100 OHM
HV+
HV–
B
A
BATTERY PACK (SEE BATTERY PACK – HIGH VOLTAGE)
E
B
D
C
HV+
HV–
FILTER
PHASE A
A
PHASE B
B
PHASE C
C
SOLID STATE
HV+ BUS BAR
HV– BUS BAR
DRIVE MOTOR
POWER INVERTER MODULE (PIM)
8
5
4
9
HV+ HV–
A
C
E
D
A1
A2
5
1
HV+ HV–
POWER STEERING CONTROL MODULE (PSCM)
HV+ HV–
CHARGE RECEPTACLE
ACCESSORY AC AND DC POWER MODULE (APM)

PSMELC67643AC

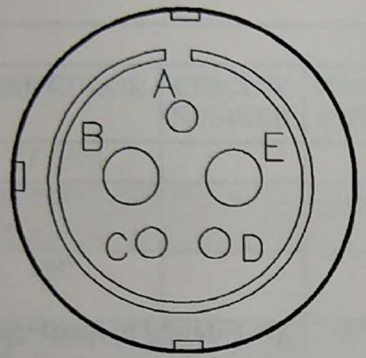
BATTERY PACK (LOW VOLTAGE–CONT.)


NOTE: ALL RESISTORS ARE 30.9K OHM
MODULE 1
MODULE 2
MODULE 3
MODULE 4
MODULE 5
MODULE 6
MODULE 7
MODULE 8
MODULE 9
MODULE 10
MODULE 11
MODULE 12
MODULE 13
MODULE 14
MODULE 15
MODULE 16
MODULE 17
MODULE 18
MODULE 19
MODULE 20
MODULE 21
MODULE 22
MODULE 23
MODULE 24
MODULE 25
MODULE 26
LT GRN 1
PPL 17
ORN 2
WHT 18
PNK 3
BLK 19
DK GRN 4
TAN 20
DK BLU 5
LT GRN 21
BLU/WHT 6
DK GRN 22
YEL 7
RED 24
BLK 9
PPL 25
GRA 10
BLU/WHT 26
TAN 11
BRN 27
PPL/WHT 12
LT BLU 28
GRA 13
LT GRN 29
YEL 14
BRN 30
BLU 15
TAN 31
LT BLU 32
RED 32-WAY (J1)
BATTERY PACK HIGH
BATTERY PACK LO
BATTERY MODULE VOLTAGE
SOLID STATE
BATTERY PACK MODULE (BPM)
BATTERY PACK

PSMELC68122AB

HARNESS CONNECTOR FACES

BATTERY PACK



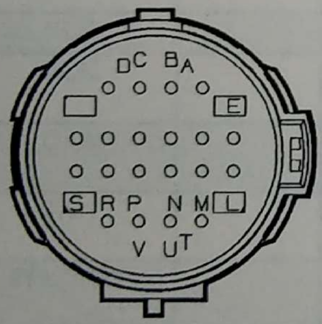
CANNON
CONNECTOR

PSMELC68240AA

BATTERY PACK CANNON CONNECTOR				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A				
B				HV–
C				HV INTERLOCK RETURN (–)
D				HV INTERLOCK (+)
E				HV (+)

Location: Underhood, Rear of Power Electronics Bay

BATTERY PACK INLINE



GRAY
12160544

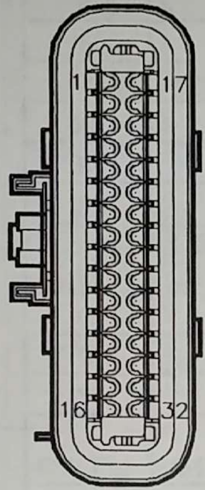
PSMELC67244AA

BATTERY PACK INLINE – 12160544				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	ORN	840B	.35	B+
B	BRN	41S	.35	RUN 1
C	LT GRN	275B	.35	PARK SELECT IN
D	WHT	26B	.35	AUTO DISCONNECT POWER SUPPLY
E	WHT	2027F	.35	VEHICLE WAKE-UP
L	PNK	213B	.35	CHARGE PORT TEMP IN
M	PPL	1807B	.35	CLASS 2 DATA
N	ORN	7K	.35	RUN 1 / WAKE-UP
P	TAN	800G	.35	SERIAL DATA
R	WHT	249	.35	AUXILIARY POWER SUPPLY COMMAND OUT
S	BLK	350E	.35	GROUND
T	WHT	108B	.35	BATT PACK FAN CONTROL OUT
U	BLK	350K	.35	GROUND
V	BLK	350S	.35	GROUND

Location: Underhood, Center Front of Dash

HARNESS CONNECTOR FACES

BATTERY PACK MODULE (J1)



12129025
WITH RED RETAINER

Location: Underbody in Battery Pack

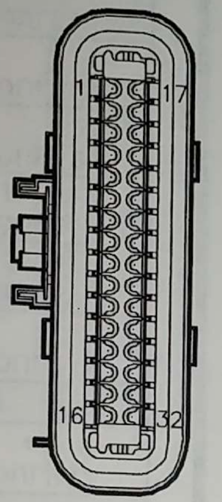
PSMELC68237AA

HARNESS CONNECTOR FACES

BATTERY PACK MODULE – J1 – 12129025

CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
1	LT GRN			BATT. PACK HI
2	ORN			BATT. MODULE 2 VOLTAGE
3	PNK			BATT. MODULE 4 VOLTAGE
4	DK GRN			BATT. MODULE 6 VOLTAGE
5	DK BLU			BATT. MODULE 8 VOLTAGE
6	DK BLU/WHT			BATT. MODULE 10 VOLTAGE
7	YEL			BATT. MODULE 12 VOLTAGE
8	BLK			SHUNT LO
9	BLK			BATT. MODULE 14 VOLTAGE
10	GRA			BATT. MODULE 16 VOLTAGE
11	TAN			BATT. MODULE 18 VOLTAGE
12	PPL/WHT			BATT. MODULE 20 VOLTAGE
13	GRA			BATT. MODULE 22 VOLTAGE
14	YEL			BATT. MODULE 24 VOLTAGE
15	DK BLU			BATT. MODULE 26 VOLTAGE
16				
17	PPL			BATT. MODULE 1 VOLTAGE
18	WHT			BATT. MODULE 3 VOLTAGE
19	BLK			BATT. MODULE 5 VOLTAGE
20	TAN			BATT. MODULE 7 VOLTAGE
21	LT GRN			BATT. MODULE 9 VOLTAGE
22	DK GRN			BATT. MODULE 11 VOLTAGE
23	WHT			SHUNT HI
24	RED			BATT. MODULE 13 VOLTAGE
25	PPL			BATT. MODULE 15 VOLTAGE
26	DK BLU/WHT			BATT. MODULE 17 VOLTAGE
27	BRN			BATT. MODULE 19 VOLTAGE
28	LT BLU			BATT. MODULE 21 VOLTAGE
29	LT GRN			BATT. MODULE 23 VOLTAGE
30	BRN			BATT. MODULE 25 VOLTAGE
31	TAN			BATT. MODULE 26 RETURN
32	LT BLU			BATTERY PACK LO

BATTERY PACK MODULE
(J2)



12129025
WITH CLEAR RETAINER

Location: Underbody, in Battery Pack

PSMELC68238AA

HARNESS CONNECTOR FACES

BATTERY PACK MODULE – J2 – 12129025 (WITH RETAINER)

CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
1	WHT			GROUND
2	PNK			RUN 1
3	GRA			B+
4	DK BLU			VEHICLE WAKE–UP
5				
6				
7	BLK			PARK SELECT
8	BLK			AD STATE “A”
9	LT BLU			AD STATE “B”
10	BRN			AD STATE “C”
11	DK GRN			AD COMMAND
12	WHT			APS COMMAND
13	PNK			AD POWER SUPPLY
14	TAN			BATT PACK FAN CONTROL
15			–	–
16	YEL			GROUND

CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
17	–	–	–	–
18	GRA			CHARGE RECEPT TEMP
19	–	–	–	–
20	BLK			AIRFLOW DETECT INPUT
21	–	–	–	–
22	LT BLU			MODULE 9 TEMP
23	GRA			MODULE 10 TEMP
24	DK GRN			MODULE 4 TEMP
25	LT GRN			MODULE 6 TEMP
26	PNK			MODULE 1 TEMP
27	PPL			MODULE 3 TEMP
28	TAN			INLET AIR TEMP
29	WHT			GROUND
30	ORN			CLASS 2 DATA
31	DK BLU			GROUND
32	DK GRN			SERIAL DATA

TEMPERATURE SENSORS

The battery pack has six temperature sensors connected to the end of battery modules #1, 3, 4, 6, 9 and 10. The sensors are variable resistance sensors which are pulled up to five volts and grounded in the batter pack module (BPM). These temperature sensors are used by the BPM for calculating battery pack state of charge (SOC), range and for charging control. The BPM uses the average battery pack temperature for SOC and other controls. The maximum battery temperature is used for charging control.

The BPM will continue to use the temperature average and maximum value until two or more temperature sensors have failed. At this time the BPM will set the Service Soon telltale and disable charging. When four temperature sensors have failed the BPM will substitute 27°C (81°F) for BP temperature.

Temperatures above 60°C (140°F) will prevent the vehicle from charging.

The normal resistances vs temperatures are shown in the table below.

TEMPERATURE °C (°F)	RESISTANCE	TEMPERATURE °C (°F)	RESISTANCE
-40C (−40)	1M	15C (59)	4.4K
-35C (−31)	72K	20C (68)	3.5K
-30C (−22)	52.4K	25C (77)	2.8K
-25C (−13)	38.5K	30C (86)	2.2K
-20C (−4)	28.5K	35C (95)	1.8K
-15C (5)	21.3K	40C (104)	1.5K
-10C (14)	16K	45C (113)	1.2K
-5C (23)	12K	50C (122)	977
0C (32)	9.4K	55C (131)	806
5C (41)	7.2K	60C (140)	669
10C (50)	5.6K	65C (149)	548
		70C (153)	467

BATTERY PACK THERMAL SYSTEM

The EV1 is equipped with a battery pack thermal system. The system consists of an airbox that contains a filter assembly, a fan, and a duct which runs at the top of the right rear wheel housing into the rear of the battery pack. When the fan is commanded On air is forced in through the rear duct into the battery tunnel and exits both at the left hand B-pillar and at the front of the battery pack. The system has two primary functions: One is to use outside air to cool down the batteries during propulsion and charging. The second is a redundant system used to purge the tunnel of any gasses caused by a vent system malfunction. (System malfunction: Leaking battery module, damage vent tube etc.).

The BPM controls the fan by sending a pulse width modulated (PWM) signal with 100% PWM = fan On (maximum). When the vehicle is initially placed in the Run mode the fan will be commanded on for 1.5 minutes and then turn Off. The fan will also come On during the propulsion mode when the battery pack temperature is above 59.25°C (138.7°F) and SOC is greater than 50 percent. During charging the fan will be commanded On when the temperature reaches 38.25°C (100.9°F). If the vehicle is in support mode the fan will come On when the temperature reaches 42.75°C (109°F). The fan will also come On and stay on during charging when the battery pack reaches 65 percent SOC. During propulsion the fan will turn On every 10 minutes at 35 percent for 1.5 minutes.

AIR INLET TEMPERATURE SENSOR

The air inlet temperature sensor is used by the battery pack module (BPM) to detect the temperature of the air being blown into the battery pack from the fan. If the temperature of the incoming air is 5.25°C (41.5°F) or less than the battery pack temperature, the fan will be commanded Off.

The normal resistances vs temperatures are shown in the table below.

TEMPERATURE °C (°F)	RESISTANCE	TEMPERATURE °C (°F)	RESISTANCE
-40C (−40)	1M	15C (59)	4.4K
-35C (−31)	72K	20C (68)	3.5K
-30C (−22)	52.4K	25C (77)	2.8K
-25C (−13)	38.5K	30C (86)	2.2K
-20C (−4)	28.5K	35C (95)	1.8K
-15C (5)	21.3K	40C (104)	1.5K
-10C (14)	16K	45C (113)	1.2K
-5C (23)	12K	50C (122)	977
0C (32)	9.4K	55C (131)	806
5C (41)	7.2K	60C (140)	669
10C (50)	5.6K	65C (149)	548
		70C (153)	467

AIR FLOW TEMPERATURE SENSOR

The air flow temperature sensor is used by the battery pack module (BPM) to verify the fan is putting air into the battery pack tunnel. The air flow temperature sensor is located on the right hand rear H-frame of the battery pack. The airflow sensor is a self-heating thermistor connected with a series resistor (30 ohms) to the Run 1/wakeup signal.

Sensor resistance:

Minimum = 70 ohms

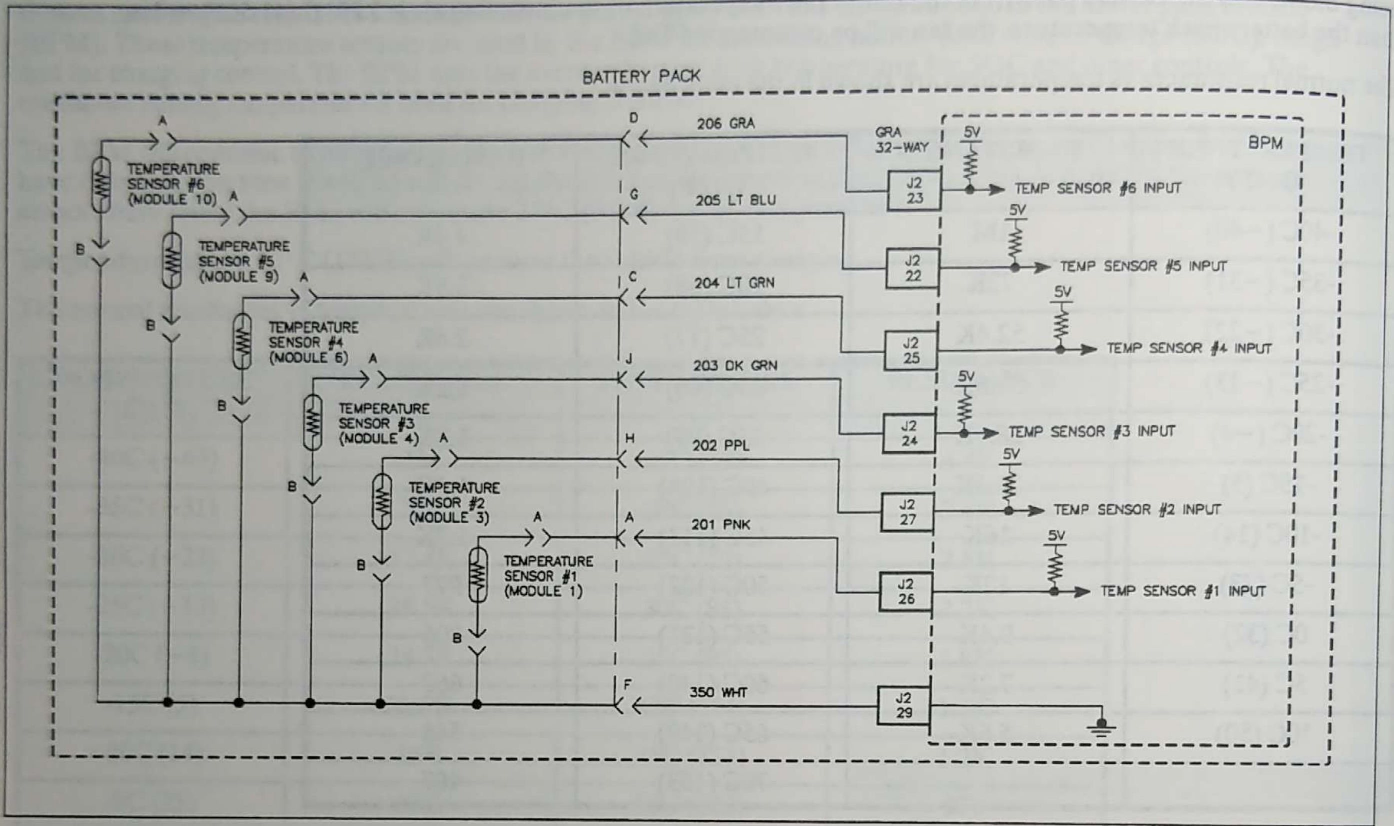
Maximum = 1000 ohms

The operating voltage is 0.5 volts to 4.5 volts.

As air blows into the battery pack the temperature sensor cools down increasing the resistance of the sensor and therefore changing the voltage level to the BPM. This indicates to the BPM that air is flowing past the sensor.

CS CamScanner

DTC 233 – BATTERY PACK TEMPERATURE SENSOR #1 OPEN/SHORT TO B+


BATTERY PACK
BPM
GRA
32-WAY
5V
TEMPERATURE SENSOR #6 (MODULE 10)
TEMPERATURE SENSOR #5 (MODULE 9)
TEMPERATURE SENSOR #4 (MODULE 6)
TEMPERATURE SENSOR #3 (MODULE 4)
TEMPERATURE SENSOR #2 (MODULE 3)
TEMPERATURE SENSOR #1 (MODULE 1)
A
B
D
206 GRA
J2 23
TEMP SENSOR #6 INPUT
G
205 LT BLU
J2 22
TEMP SENSOR #5 INPUT
C
204 LT GRN
J2 25
TEMP SENSOR #4 INPUT
J
203 DK GRN
J2 24
TEMP SENSOR #3 INPUT
H
202 PPL
J2 27
TEMP SENSOR #2 INPUT
A
201 PNK
J2 26
TEMP SENSOR #1 INPUT
F
350 WHT
J2 29

PSMELC68200AA

BATTERY PACK TEMPERATURE SENSOR #1 OPEN/SHORT TO B+

There are six temperature sensors located within the battery pack. The temperature sensors are used to determine the temperature of the batteries within the battery pack. This information is used to calculate state of charge (SOC) and to control charging and the battery pack fan. If one of the six sensors fail, the battery pack module (BPM) will use the other remaining five sensors to calculate the battery temperature.

DTC PARAMETERS

This DTC will set anytime the BPM sees the resistance of the temperature sensor exceed 548 ohms.

ACTION TAKEN

- The DTC is set and the BPM temperature value will read −19°C (−2°F).
- Two or more failed sensors illuminate SERVICE SOON telltale and disable charging.
- Four or more failed sensors BPM substitutes 27°C (81°F) for pack temperature. SOC information could be inaccurate.
- If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

SERVICE SOON

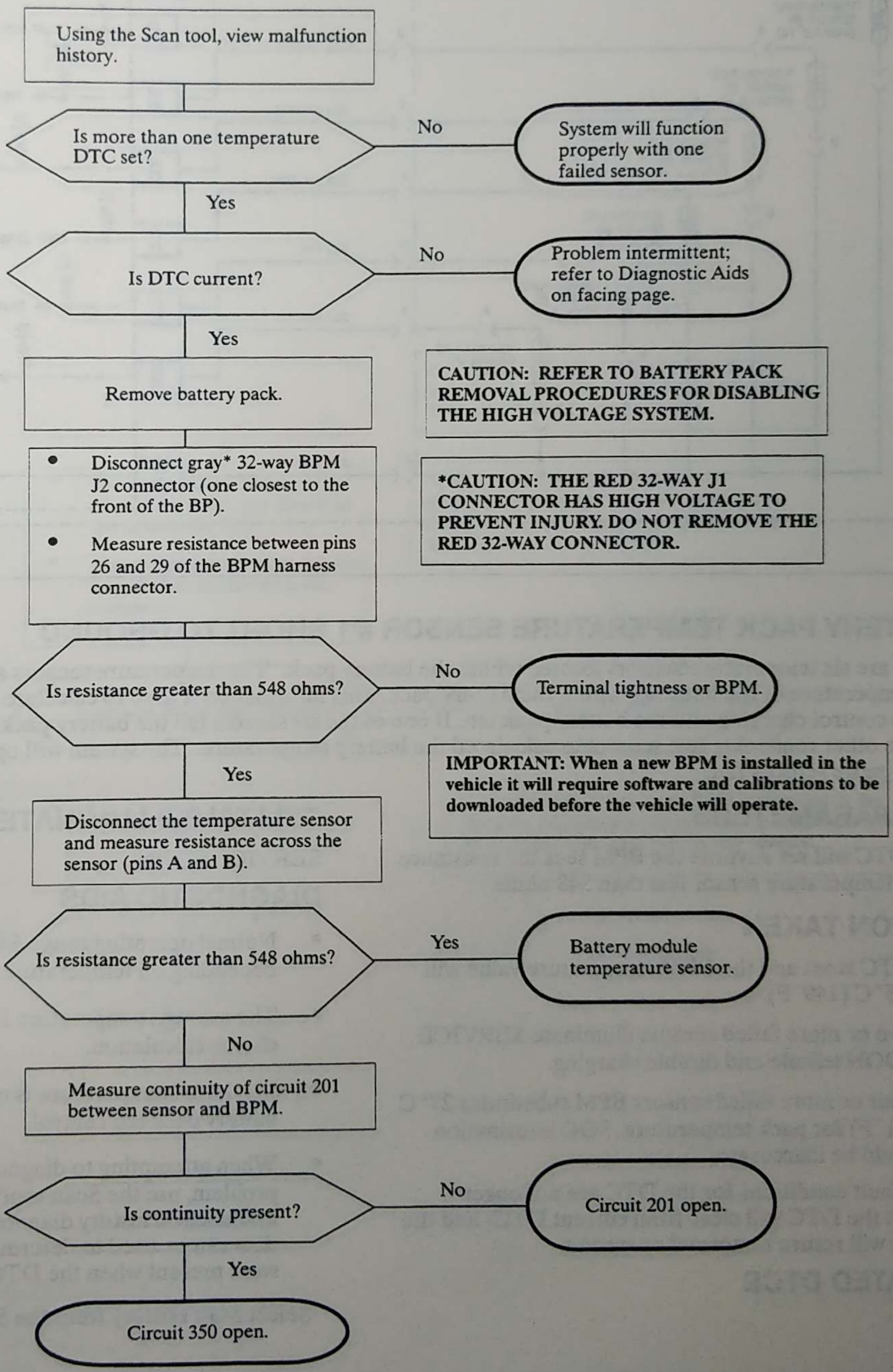
DIAGNOSTIC AIDS

- Normal operating range 548 ohms to 29K ohms depending on temperature.
- The average temperature is used for state of charge calculation.
- Maximum temperature is used for charging and battery pack fan control.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 233

BATTERY PACK TEMPERATURE SENSOR #1 OPEN/SHORT TO B+


Using the Scan tool, view malfunction history.
Is more than one temperature DTC set?
No
System will function properly with one failed sensor.
Yes
Is DTC current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Remove battery pack.
Disconnect gray* 32-way BPM J2 connector (one closest to the front of the BP).
Measure resistance between pins 26 and 29 of the BPM harness connector.
Is resistance greater than 548 ohms?
No
Terminal tightness or BPM.
Yes
Disconnect the temperature sensor and measure resistance across the sensor (pins A and B).
Is resistance greater than 548 ohms?
Yes
Battery module temperature sensor.
No
Measure continuity of circuit 201 between sensor and BPM.
Is continuity present?
No
Circuit 201 open.
Yes
Circuit 350 open.

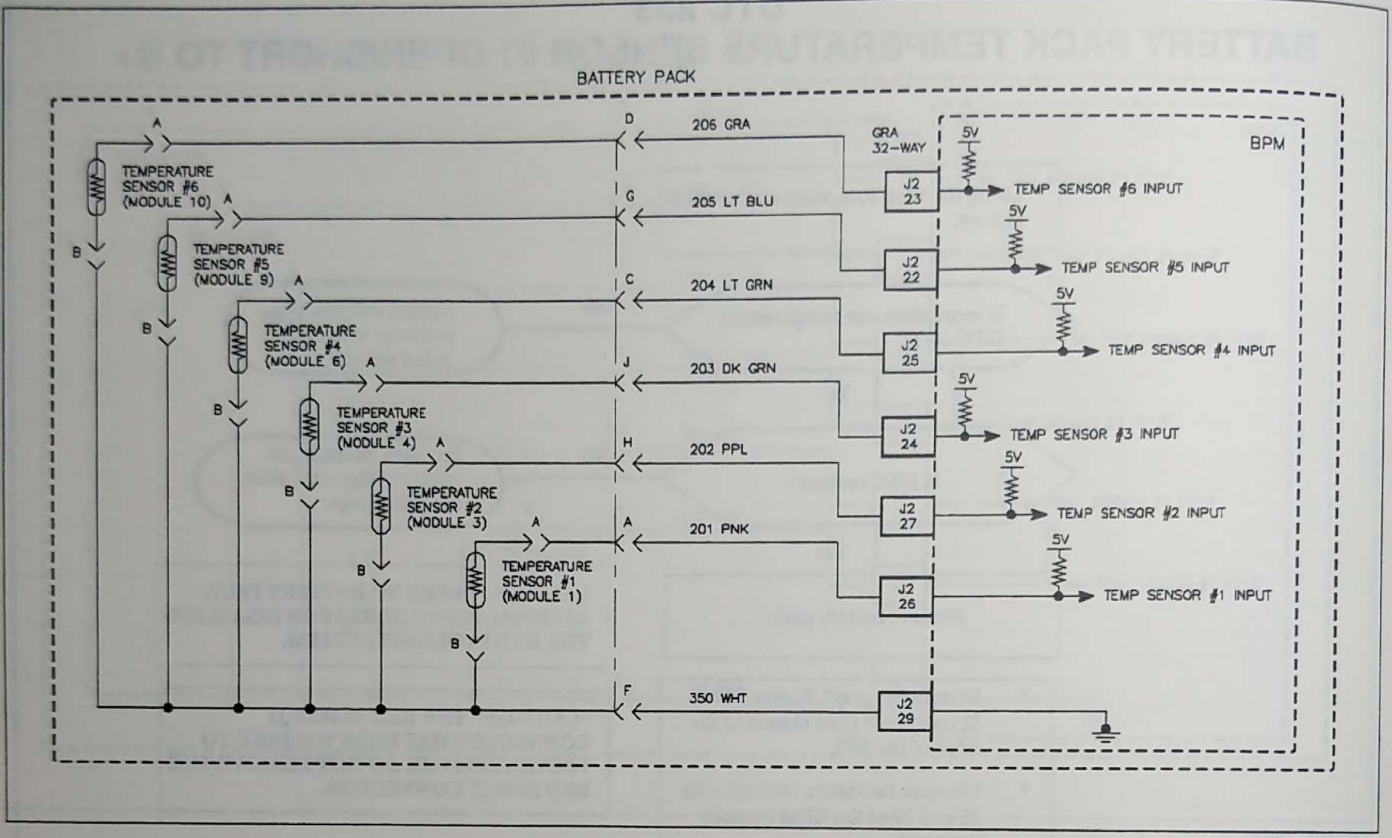
CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.

***CAUTION: THE RED 32-WAY J1 CONNECTOR HAS HIGH VOLTAGE TO PREVENT INJURY. DO NOT REMOVE THE RED 32-WAY CONNECTOR.**

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

CS CamScanner

DTC 234 – BATTERY PACK TEMPERATURE SENSOR #1 SHORT TO GROUND


BATTERY PACK
BPM
GRA 32-WAY
TEMPERATURE SENSOR #6 (MODULE 10)
TEMPERATURE SENSOR #5 (MODULE 9)
TEMPERATURE SENSOR #4 (MODULE 6)
TEMPERATURE SENSOR #3 (MODULE 4)
TEMPERATURE SENSOR #2 (MODULE 3)
TEMPERATURE SENSOR #1 (MODULE 1)
A
B
D
G
C
J
H
F
206 GRA
205 LT BLU
204 LT GRN
203 DK GRN
202 PPL
201 PNK
350 WHT
J2 23
J2 22
J2 25
J2 24
J2 27
J2 26
J2 29
5V
TEMP SENSOR #6 INPUT
TEMP SENSOR #5 INPUT
TEMP SENSOR #4 INPUT
TEMP SENSOR #3 INPUT
TEMP SENSOR #2 INPUT
TEMP SENSOR #1 INPUT

PSMELC68200AA

BATTERY PACK TEMPERATURE SENSOR #1 SHORT TO GROUND

There are six temperature sensors located within the battery pack. The temperature sensors are used to determine the temperature of the batteries within the battery pack. This information is used to calculate state of charge (SOC) and to control charging and the battery pack fan. If one of the six sensors fail the battery pack module (BPM) will use the other remaining five sensors to calculated the battery temperature. The system will operate normally until two or more sensors fail.

DTC PARAMETERS

This DTC will set anytime the BPM sees the resistance of the temperature sensor less than 548 ohms.

ACTION TAKEN

The DTC is set and the BPM temperature value will read 65°C (149°F).

- Two or more failed sensors illuminate SERVICE SOON telltale and disable charging.
- Four or more failed sensors BPM substitutes 27°C (81°F) for pack temperature. SOC information could be inaccurate.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

SERVICE SOON

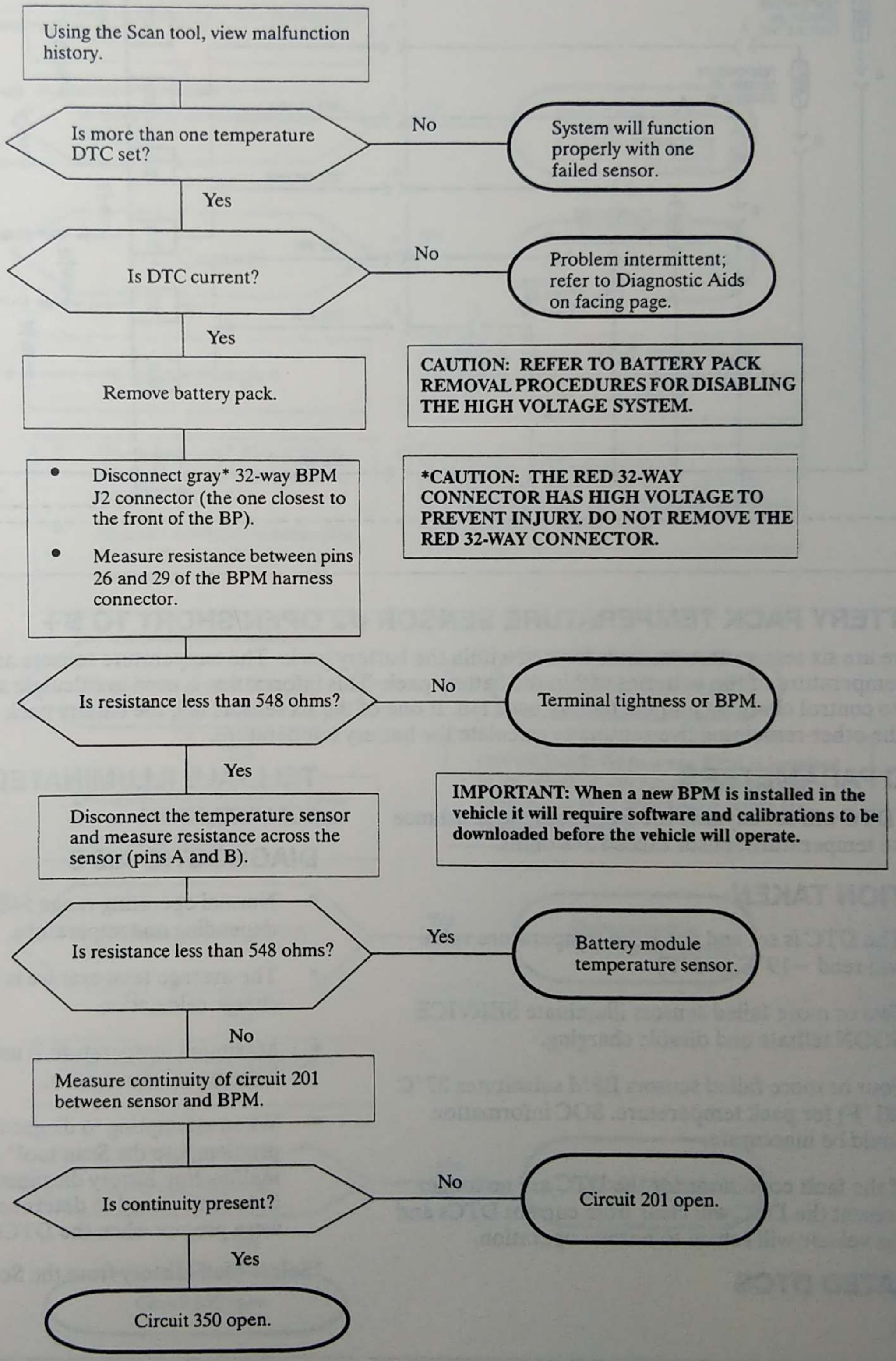
DIAGNOSTIC AIDS

- Normal operating range 548 ohms to 29K ohms depending on temperature.
- The average temperature is used for state of charge calculation.
- Maximum temperature is used for charging and battery pack fan control.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

CS CamScanner

DTC 234
BATTERY PACK TEMPERATURE SENSOR #1 SHORT TO GROUND

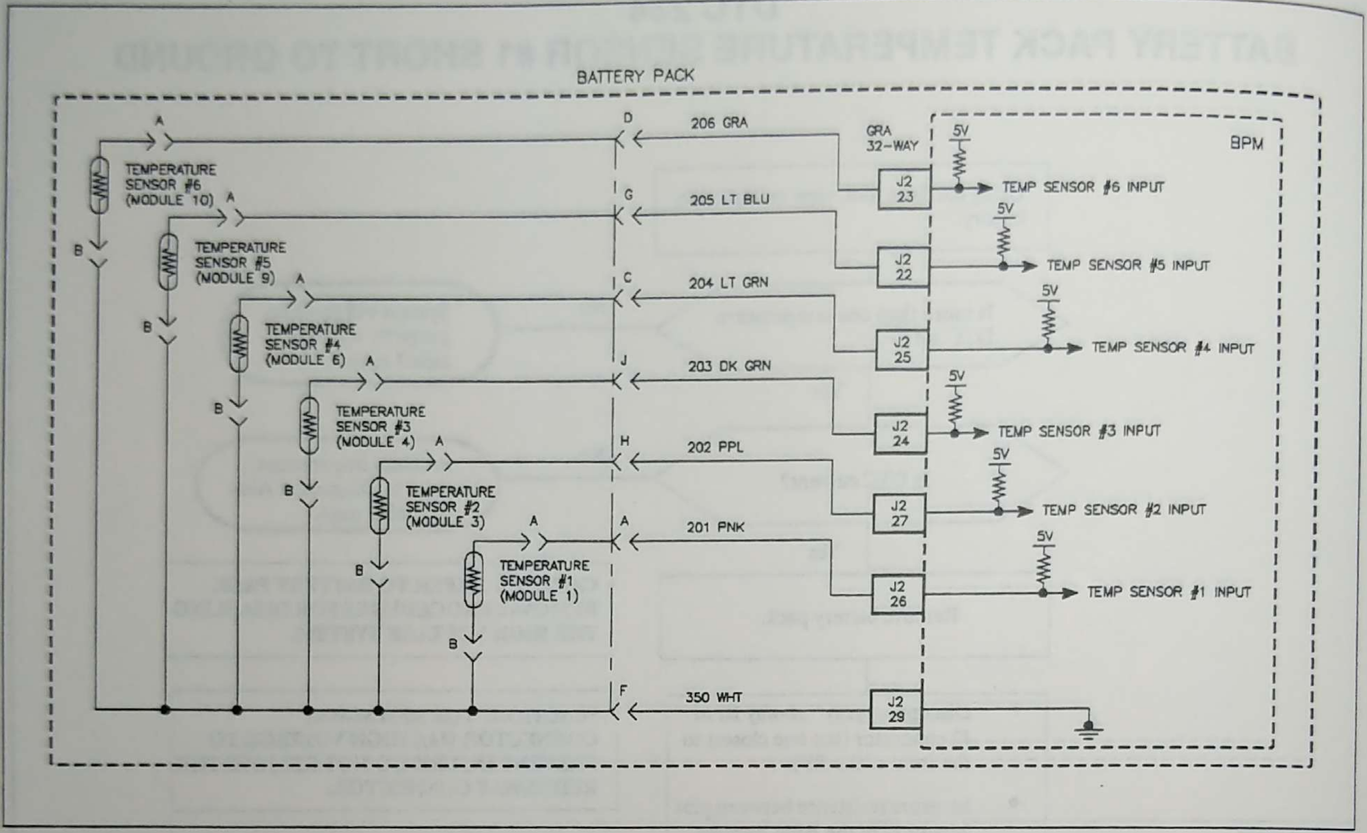

Using the Scan tool, view malfunction history.
Is more than one temperature DTC set?
No
System will function properly with one failed sensor.
Yes
Is DTC current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Remove battery pack.
Disconnect gray* 32-way BPM J2 connector (the one closest to the front of the BP).
Measure resistance between pins 26 and 29 of the BPM harness connector.
Is resistance less than 548 ohms?
No
Terminal tightness or BPM.
Yes
Disconnect the temperature sensor and measure resistance across the sensor (pins A and B).
Is resistance less than 548 ohms?
Yes
Battery module temperature sensor.
No
Measure continuity of circuit 201 between sensor and BPM.
Is continuity present?
No
Circuit 201 open.
Yes
Circuit 350 open.

CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.

***CAUTION: THE RED 32-WAY CONNECTOR HAS HIGH VOLTAGE TO PREVENT INJURY. DO NOT REMOVE THE RED 32-WAY CONNECTOR.**

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 237 – BATTERY PACK TEMPERATURE SENSOR #2 OPEN/SHORT TO B+


BATTERY PACK
TEMPERATURE SENSOR #6 (MODULE 10)
TEMPERATURE SENSOR #5 (MODULE 9)
TEMPERATURE SENSOR #4 (MODULE 6)
TEMPERATURE SENSOR #3 (MODULE 4)
TEMPERATURE SENSOR #2 (MODULE 3)
TEMPERATURE SENSOR #1 (MODULE 1)
A
B
D
G
C
J
H
A
F
206 GRA
205 LT BLU
204 LT GRN
203 DK GRN
202 PPL
201 PNK
350 WHT
GRA 32-WAY
J2 23
J2 22
J2 25
J2 24
J2 27
J2 26
J2 29
BPM
5V
TEMP SENSOR #6 INPUT
TEMP SENSOR #5 INPUT
TEMP SENSOR #4 INPUT
TEMP SENSOR #3 INPUT
TEMP SENSOR #2 INPUT
TEMP SENSOR #1 INPUT

PSMELC68200AA

BATTERY PACK TEMPERATURE SENSOR #2 OPEN/SHORT TO B+

There are six temperature sensors located within the battery pack. The temperature sensors are used to determine the temperature of the batteries within the battery pack. This information is used to calculate state of charge (SOC) and to control charging and the battery pack fan. If one of the six sensors fail, the battery pack module (BPM) will use the other remaining five sensors to calculate the battery temperature.

DTC PARAMETERS

This DTC will set anytime the BPM sees the resistance of the temperature sensor exceed 548 ohms.

ACTION TAKEN

- The DTC is set and the BPM temperature value will read −19°C (−2°F).
- Two or more failed sensors illuminate SERVICE SOON telltale and disable charging.
- Four or more failed sensors BPM substitutes 27°C (81°F) for pack temperature. SOC information could be inaccurate.
- If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

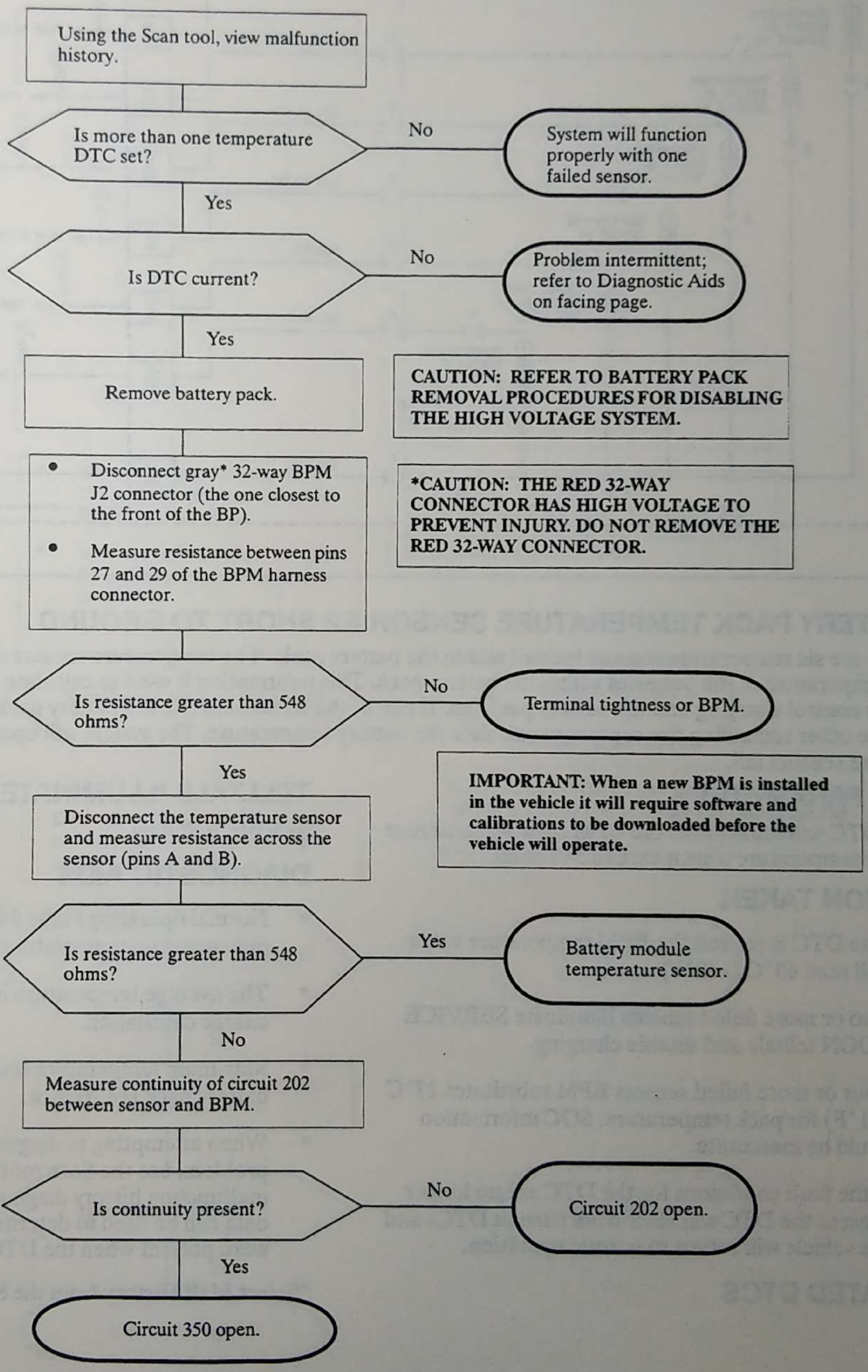
SERVICE SOON

DIAGNOSTIC AIDS

- Normal operating range 548 ohms to 29K ohms depending on temperature.
- The average temperature is used for state of charge calculation.
- Maximum temperature is used for charging and battery pack fan control.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 237
BATTERY PACK TEMPERATURE SENSOR #2 OPEN/SHORT TO B+

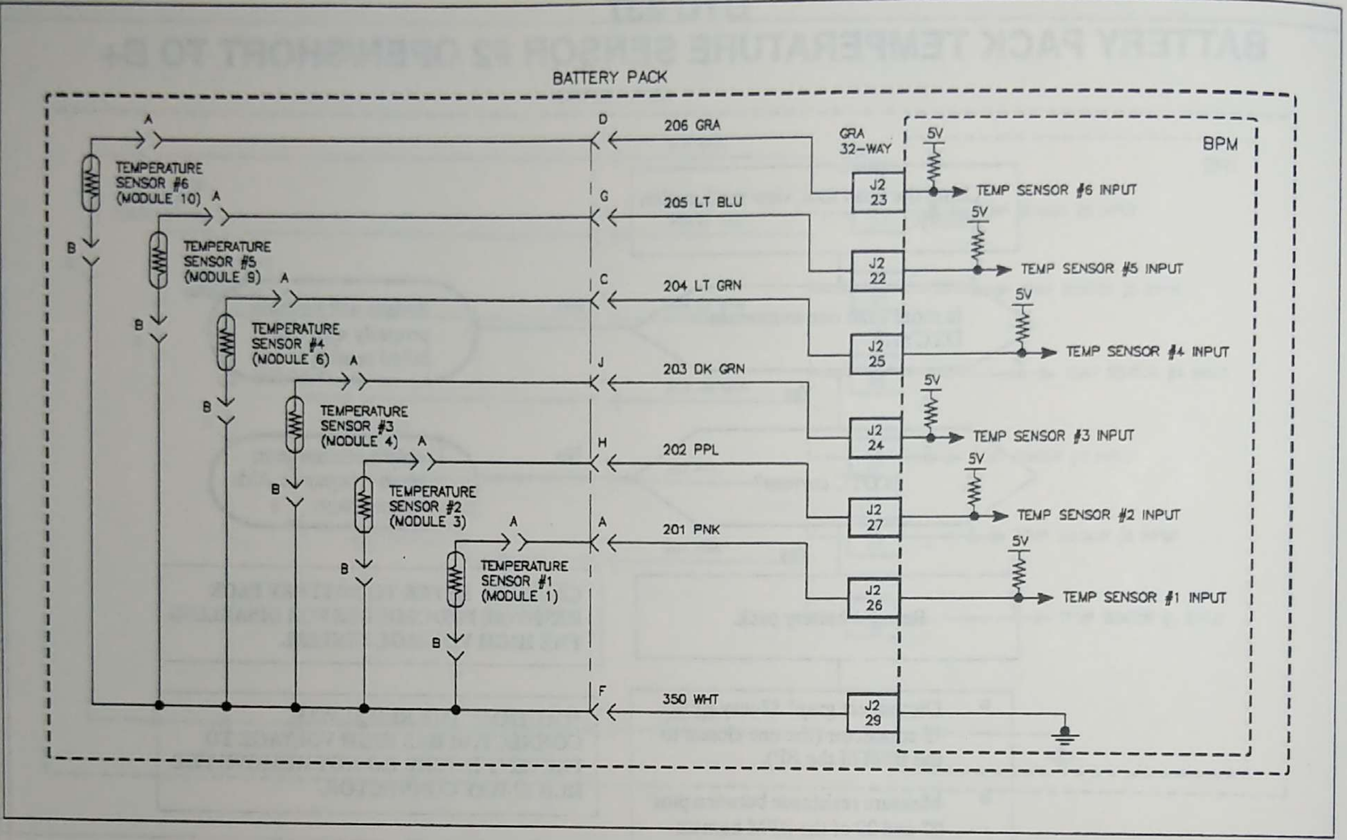

Using the Scan tool, view malfunction history.
Is more than one temperature DTC set?
No
System will function properly with one failed sensor.
Yes
Is DTC current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Remove battery pack.
• Disconnect gray* 32-way BPM J2 connector (the one closest to the front of the BP).
• Measure resistance between pins 27 and 29 of the BPM harness connector.
Is resistance greater than 548 ohms?
No
Terminal tightness or BPM.
Yes
Disconnect the temperature sensor and measure resistance across the sensor (pins A and B).
Is resistance greater than 548 ohms?
Yes
Battery module temperature sensor.
No
Measure continuity of circuit 202 between sensor and BPM.
Is continuity present?
No
Circuit 202 open.
Yes
Circuit 350 open.

CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.

***CAUTION: THE RED 32-WAY CONNECTOR HAS HIGH VOLTAGE TO PREVENT INJURY. DO NOT REMOVE THE RED 32-WAY CONNECTOR.**

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 238 – BATTERY PACK TEMPERATURE SENSOR #2 SHORT TO GROUND


BATTERY PACK
BPM
GRA
32–WAY
TEMPERATURE SENSOR #6 (MODULE 10)
TEMPERATURE SENSOR #5 (MODULE 9)
TEMPERATURE SENSOR #4 (MODULE 6)
TEMPERATURE SENSOR #3 (MODULE 4)
TEMPERATURE SENSOR #2 (MODULE 3)
TEMPERATURE SENSOR #1 (MODULE 1)
A
B
D
G
C
J
H
F
206 GRA
205 LT BLU
204 LT GRN
203 DK GRN
202 PPL
201 PNK
350 WHT
J2 23
J2 22
J2 25
J2 24
J2 27
J2 26
J2 29
5V
TEMP SENSOR #6 INPUT
TEMP SENSOR #5 INPUT
TEMP SENSOR #4 INPUT
TEMP SENSOR #3 INPUT
TEMP SENSOR #2 INPUT
TEMP SENSOR #1 INPUT

PSMELC68200AA

BATTERY PACK TEMPERATURE SENSOR #2 SHORT TO GROUND

There are six temperature sensors located within the battery pack. The temperature sensors are used to determine the temperature of the batteries within the battery pack. This information is used to calculate state of charge (SOC) and to control charging and the battery pack fan. If one of the six sensors fail, the battery pack module (BPM) will use the other remaining five sensors to calculate the battery temperature. The system will operate normally until two or more sensors fail.

DTC PARAMETERS

This DTC will set anytime the BPM sees the resistance of the temperature sensor exceed 548 ohms.

ACTION TAKEN

- The DTC is set and the BPM temperature value will read 65°C (149°F).
- Two or more failed sensors illuminate SERVICE SOON telltale and disable charging.
- Four or more failed sensors BPM substitutes 27°C (81°F) for pack temperature. SOC information could be inaccurate.
- If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

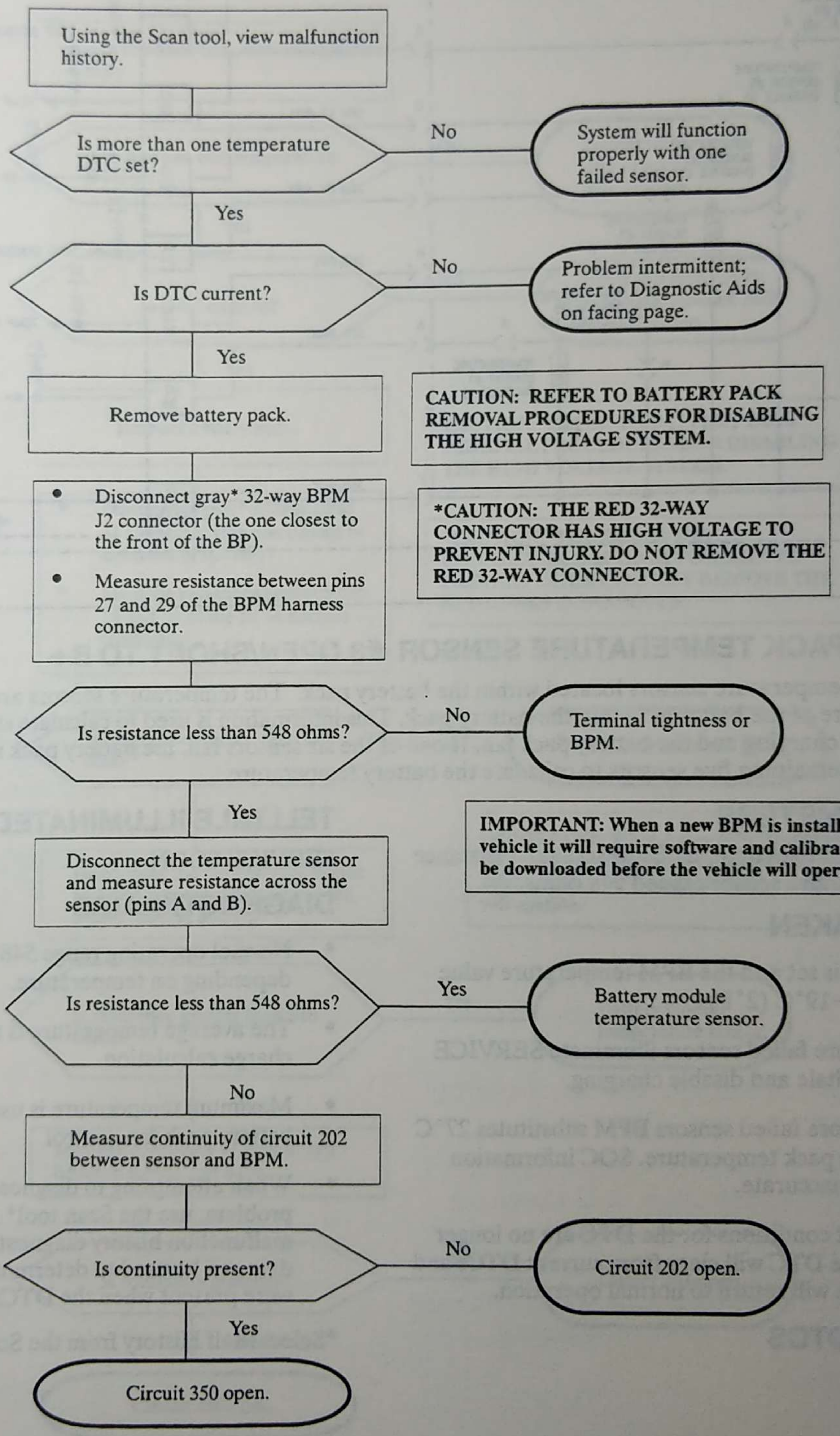
SERVICE SOON

DIAGNOSTIC AIDS

- Normal operating range 548 ohms to 29K ohms depending on temperature.
- The average temperature is used for state of charge calculation.
- Maximum temperature is used for charging and battery pack fan control.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 238
BATTERY PACK TEMPERATURE SENSOR #2 SHORT TO GROUND


Using the Scan tool, view malfunction history.
Is more than one temperature DTC set?
No
System will function properly with one failed sensor.
Yes
Is DTC current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Remove battery pack.
Disconnect gray* 32-way BPM J2 connector (the one closest to the front of the BP).
Measure resistance between pins 27 and 29 of the BPM harness connector.
Is resistance less than 548 ohms?
No
Terminal tightness or BPM.
Yes
Disconnect the temperature sensor and measure resistance across the sensor (pins A and B).
Is resistance less than 548 ohms?
Yes
Battery module temperature sensor.
No
Measure continuity of circuit 202 between sensor and BPM.
Is continuity present?
No
Circuit 202 open.
Yes
Circuit 350 open.

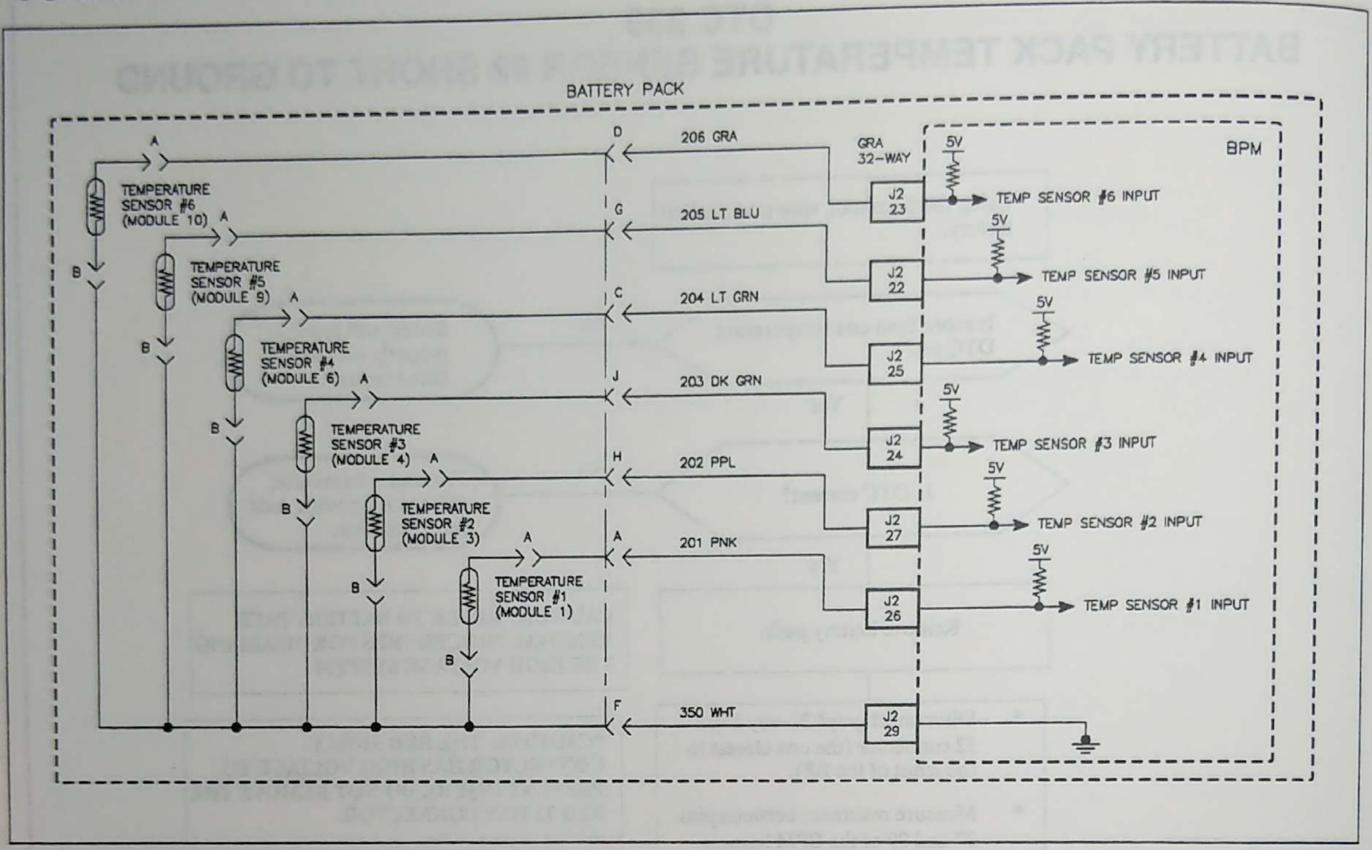
CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.

***CAUTION: THE RED 32-WAY CONNECTOR HAS HIGH VOLTAGE TO PREVENT INJURY. DO NOT REMOVE THE RED 32-WAY CONNECTOR.**

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

CS CamScanner

DTC 241 – BATTERY PACK TEMPERATURE SENSOR #3 OPEN/SHORT TO B+


BATTERY PACK
BPM
GRA 32-WAY
TEMPERATURE SENSOR #6 (MODULE 10)
TEMPERATURE SENSOR #5 (MODULE 9)
TEMPERATURE SENSOR #4 (MODULE 6)
TEMPERATURE SENSOR #3 (MODULE 4)
TEMPERATURE SENSOR #2 (MODULE 3)
TEMPERATURE SENSOR #1 (MODULE 1)
A
B
D
G
C
J
H
F
206 GRA
205 LT BLU
204 LT GRN
203 DK GRN
202 PPL
201 PNK
350 WHT
J2 23
J2 22
J2 25
J2 24
J2 27
J2 26
J2 29
5V
TEMP SENSOR #6 INPUT
TEMP SENSOR #5 INPUT
TEMP SENSOR #4 INPUT
TEMP SENSOR #3 INPUT
TEMP SENSOR #2 INPUT
TEMP SENSOR #1 INPUT

PSMELC68200AA

BATTERY PACK TEMPERATURE SENSOR #3 OPEN/SHORT TO B+

There are six temperature sensors located within the battery pack. The temperature sensors are used to determine the temperature of the batteries within the battery pack. This information is used to calculate state of charge (SOC) and to control charging and the battery pack fan. If one of the six sensors fail, the battery pack module (BPM) will use the other remaining five sensors to calculate the battery temperature.

DTC PARAMETERS

This DTC will set anytime the BPM sees the resistance of the temperature sensor exceed 548 ohms.

ACTION TAKEN

- The DTC is set and the BPM temperature value will read −19°C (2°F).
- Two or more failed sensors illuminate SERVICE SOON telltale and disable charging.
- Four or more failed sensors BPM substitutes 27°C (81°F) for pack temperature. SOC information could be inaccurate.
- If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

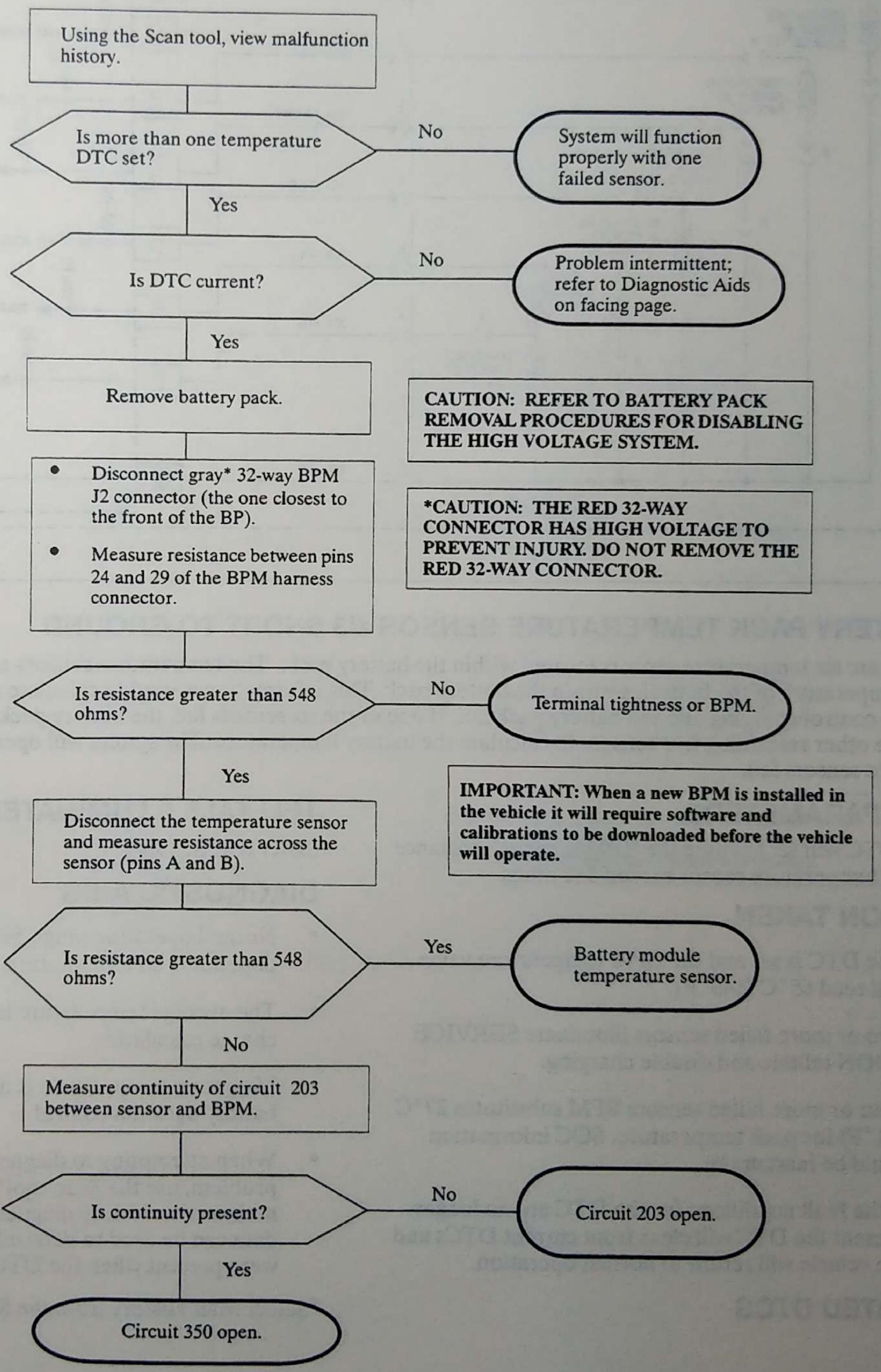
- Normal operating range 548 ohms to 29K ohms depending on temperature.
- The average temperature is used for state of charge calculation.
- Maximum temperature is used for charging and battery pack fan control.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

CS CamScanner

DTC 241

BATTERY PACK TEMPERATURE SENSOR #3 OPEN/SHORT TO B+

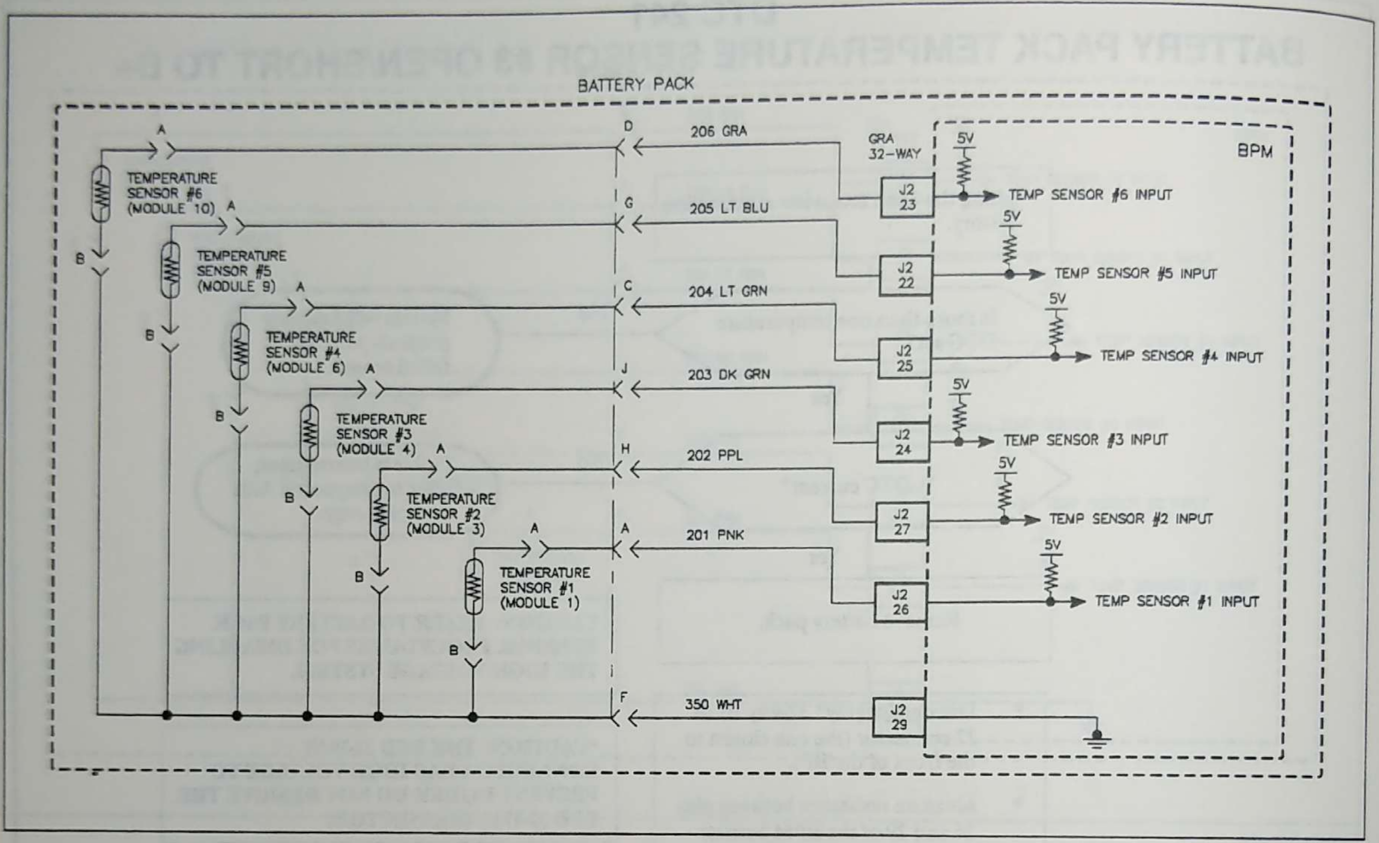

Using the Scan tool, view malfunction history.
Is more than one temperature DTC set?
No
System will function properly with one failed sensor.
Yes
Is DTC current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Remove battery pack.
• Disconnect gray* 32-way BPM J2 connector (the one closest to the front of the BP).
• Measure resistance between pins 24 and 29 of the BPM harness connector.
Is resistance greater than 548 ohms?
No
Terminal tightness or BPM.
Yes
Disconnect the temperature sensor and measure resistance across the sensor (pins A and B).
Is resistance greater than 548 ohms?
Yes
Battery module temperature sensor.
No
Measure continuity of circuit 203 between sensor and BPM.
Is continuity present?
No
Circuit 203 open.
Yes
Circuit 350 open.

CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.

***CAUTION: THE RED 32-WAY CONNECTOR HAS HIGH VOLTAGE TO PREVENT INJURY. DO NOT REMOVE THE RED 32-WAY CONNECTOR.**

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 242 – BATTERY PACK TEMPERATURE SENSOR #3 SHORT TO GROUND


BATTERY PACK
A
TEMPERATURE SENSOR #6 (MODULE 10)
B
A
TEMPERATURE SENSOR #5 (MODULE 9)
B
A
TEMPERATURE SENSOR #4 (MODULE 6)
B
A
TEMPERATURE SENSOR #3 (MODULE 4)
B
A
TEMPERATURE SENSOR #2 (MODULE 3)
B
A
TEMPERATURE SENSOR #1 (MODULE 1)
B
D
G
C
J
H
A
F
206 GRA
205 LT BLU
204 LT GRN
203 DK GRN
202 PPL
201 PNK
350 WHT
GRA 32-WAY
J2 23
J2 22
J2 25
J2 24
J2 27
J2 26
J2 29
5V
BPM
TEMP SENSOR #6 INPUT
TEMP SENSOR #5 INPUT
TEMP SENSOR #4 INPUT
TEMP SENSOR #3 INPUT
TEMP SENSOR #2 INPUT
TEMP SENSOR #1 INPUT

PSMELC68200AA

BATTERY PACK TEMPERATURE SENSOR #3 SHORT TO GROUND

There are six temperature sensors located within the battery pack. The temperature sensors are used to determine the temperature of the batteries within the battery pack. This information is used to calculate state of charge (SOC) and to control charging and the battery pack fan. If one of the six sensors fail, the battery pack module (BPM) will use the other remaining five sensors to calculate the battery temperature. The system will operate normally until two or more sensors fail.

DTC PARAMETERS

This DTC will set anytime the BPM sees the resistance of the temperature sensor exceed 548 ohms.

ACTION TAKEN

- The DTC is set and the BPM temperature value will read 65°C (149°F).
- Two or more failed sensors illuminate SERVICE SOON telltale and disable charging.
- Four or more failed sensors BPM substitutes 27°C (81°F) for pack temperature. SOC information could be inaccurate.
- If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

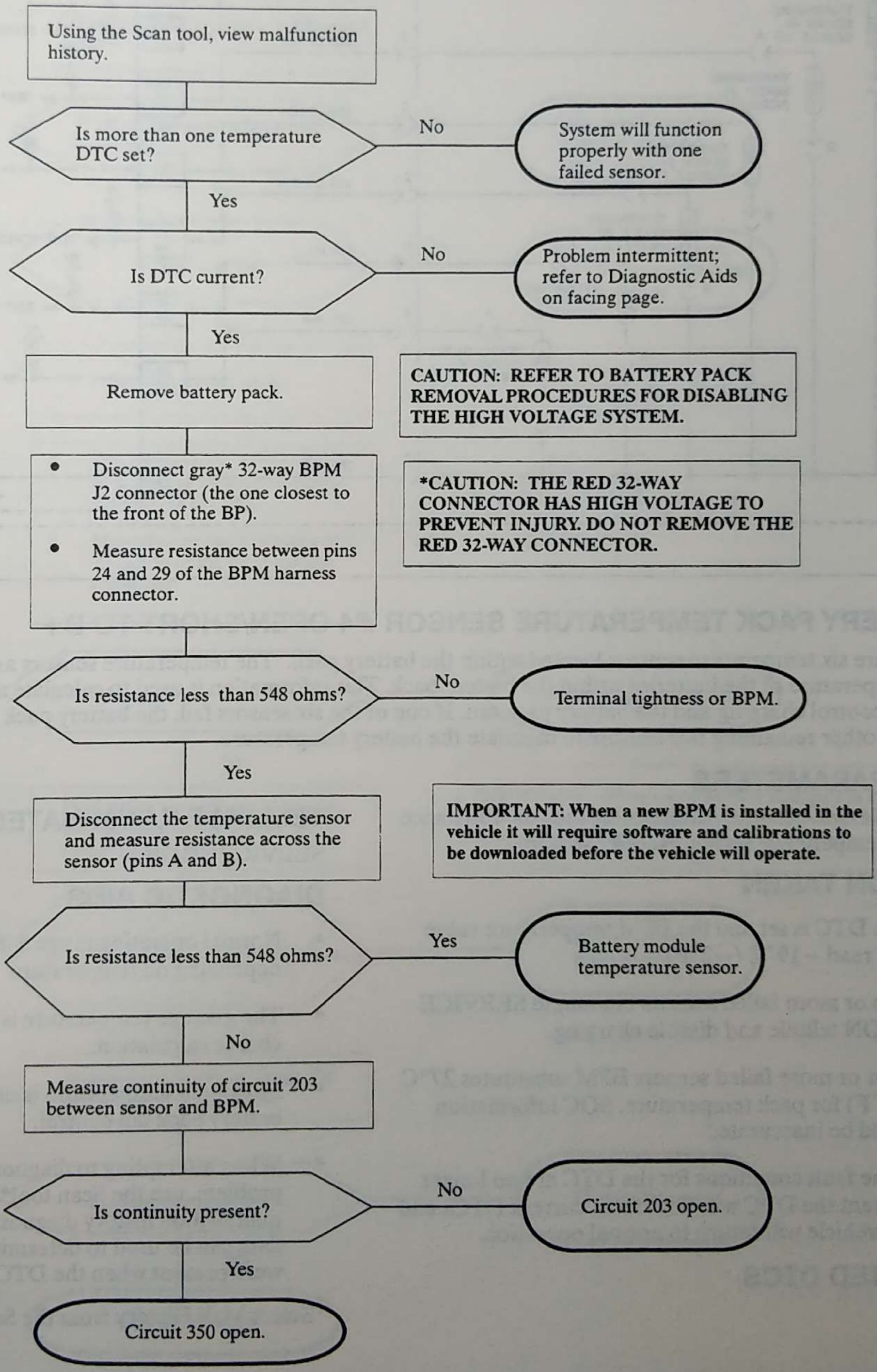
SERVICE SOON

DIAGNOSTIC AIDS

- Normal operating range 548 ohms to 29K ohms depending on temperature.
- The average temperature is used for state of charge calculation.
- Maximum temperature is used for charging and battery pack fan control.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 242
BATTERY PACK TEMPERATURE SENSOR #3 SHORT TO GROUND

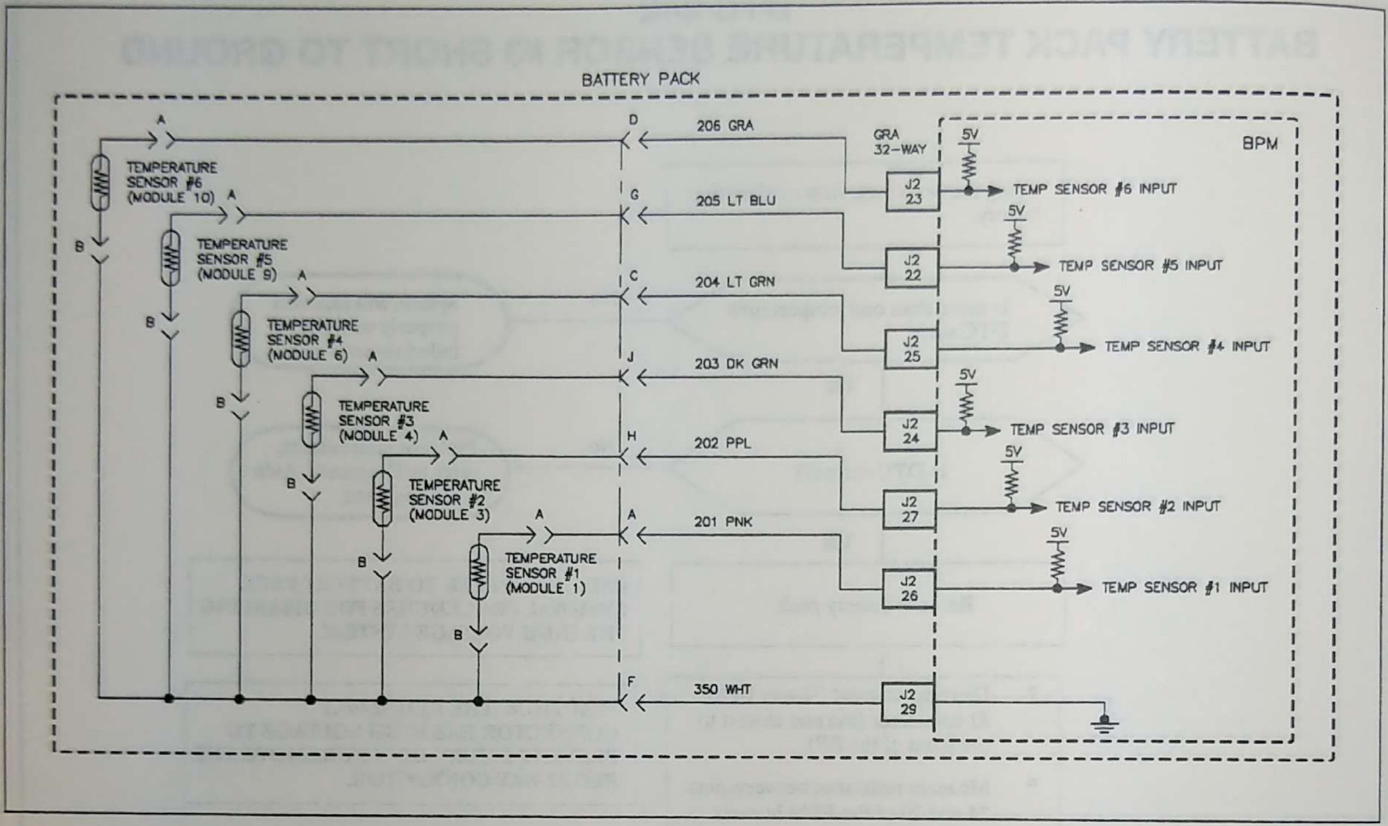

Using the Scan tool, view malfunction history.
Is more than one temperature DTC set?
No
System will function properly with one failed sensor.
Yes
Is DTC current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Remove battery pack.
• Disconnect gray* 32-way BPM J2 connector (the one closest to the front of the BP).
• Measure resistance between pins 24 and 29 of the BPM harness connector.
Is resistance less than 548 ohms?
No
Terminal tightness or BPM.
Yes
Disconnect the temperature sensor and measure resistance across the sensor (pins A and B).
Is resistance less than 548 ohms?
Yes
Battery module temperature sensor.
No
Measure continuity of circuit 203 between sensor and BPM.
Is continuity present?
No
Circuit 203 open.
Yes
Circuit 350 open.

CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.

***CAUTION: THE RED 32-WAY CONNECTOR HAS HIGH VOLTAGE TO PREVENT INJURY. DO NOT REMOVE THE RED 32-WAY CONNECTOR.**

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 245 – BATTERY PACK TEMPERATURE SENSOR #4 OPEN/SHORT TO B+


BATTERY PACK
TEMPERATURE SENSOR #6 (MODULE 10)
TEMPERATURE SENSOR #5 (MODULE 9)
TEMPERATURE SENSOR #4 (MODULE 6)
TEMPERATURE SENSOR #3 (MODULE 4)
TEMPERATURE SENSOR #2 (MODULE 3)
TEMPERATURE SENSOR #1 (MODULE 1)
A
B
D
G
C
J
H
F
206 GRA
205 LT BLU
204 LT GRN
203 DK GRN
202 PPL
201 PNK
350 WHT
GRA 32-WAY
J2 23
J2 22
J2 25
J2 24
J2 27
J2 26
J2 29
5V
BPM
TEMP SENSOR #6 INPUT
TEMP SENSOR #5 INPUT
TEMP SENSOR #4 INPUT
TEMP SENSOR #3 INPUT
TEMP SENSOR #2 INPUT
TEMP SENSOR #1 INPUT

PSMELC68200AA

BATTERY PACK TEMPERATURE SENSOR #4 OPEN/SHORT TO B+

There are six temperature sensors located within the battery pack. The temperature sensors are used to determine the temperature of the batteries within the battery pack. This information is used to calculate state of charge (SOC) and to control charging and the battery pack fan. If one of the six sensors fail, the battery pack module (BPM) will use the other remaining five sensors to calculate the battery temperature.

DTC PARAMETERS

This DTC will set anytime the BPM sees the resistance of the temperature sensor exceed 548 ohms.

ACTION TAKEN

- The DTC is set and the BPM temperature value will read −19°C (−2°F).
- Two or more failed sensors illuminate SERVICE SOON telltale and disable charging.
- Four or more failed sensors BPM substitutes 27°C (81°F) for pack temperature. SOC information could be inaccurate.
- If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

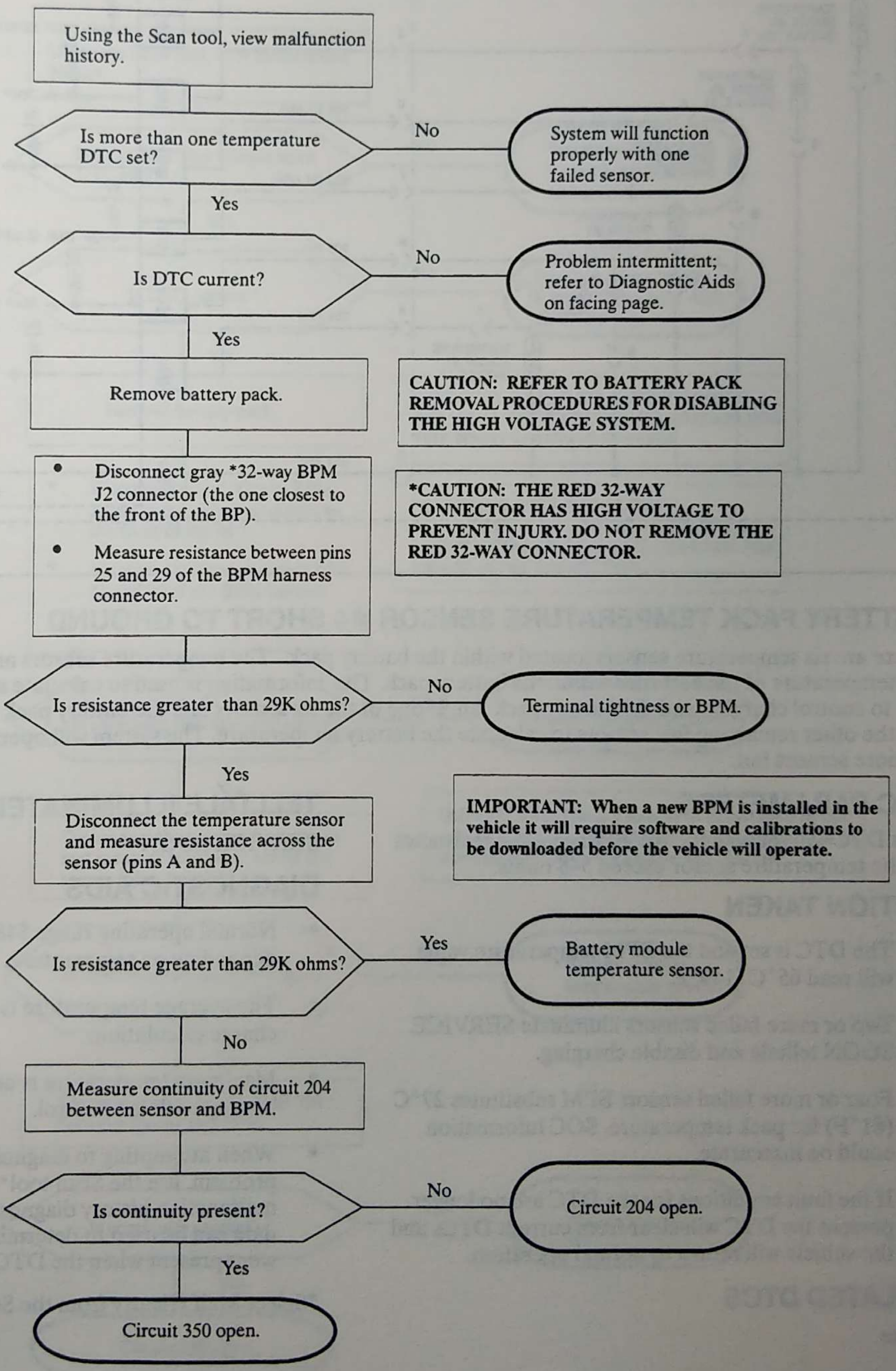
SERVICE SOON

DIAGNOSTIC AIDS

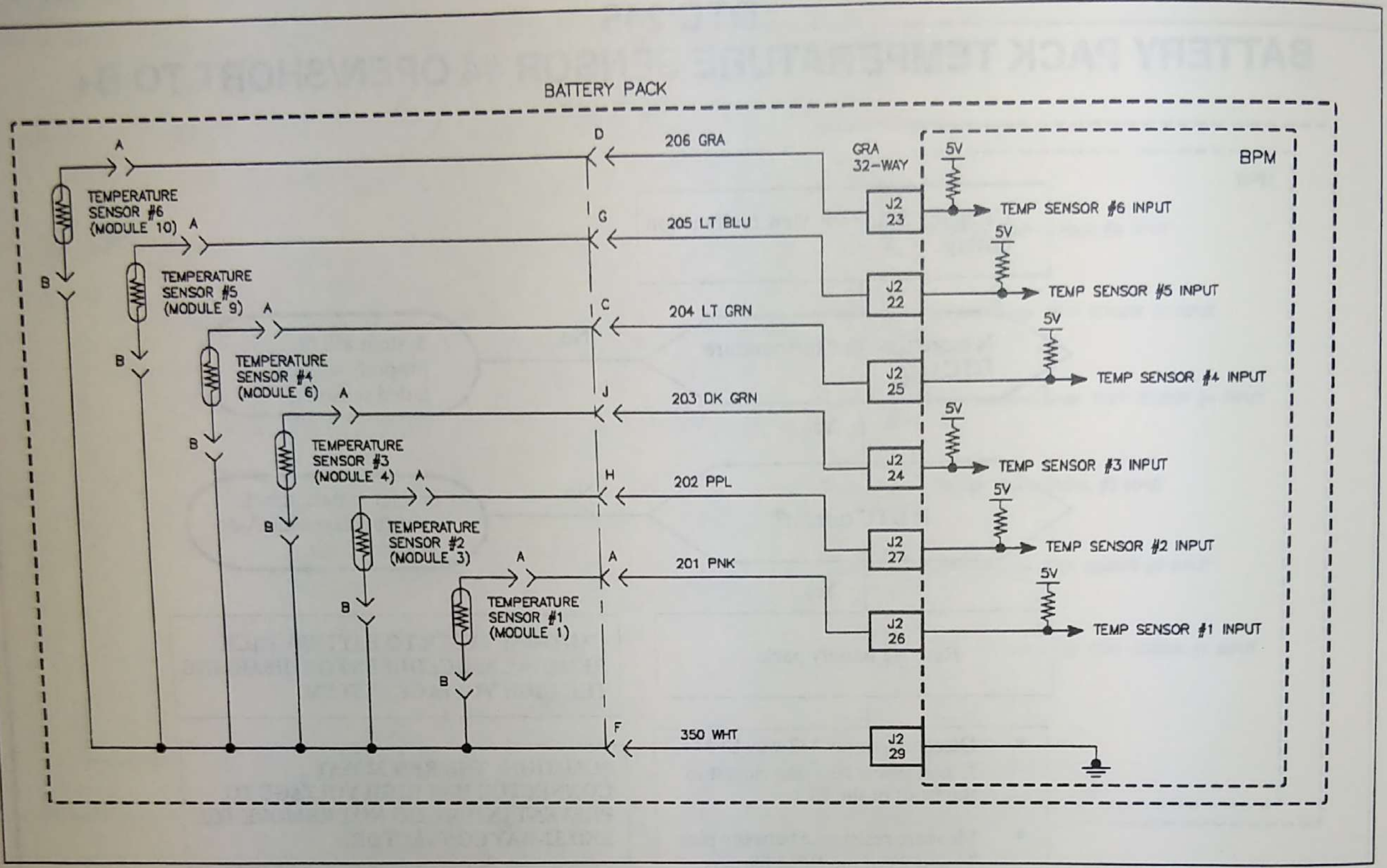
- Normal operating range 548 ohms to 29K ohms depending on temperature.
- The average temperature is used for state of charge calculation.
- Maximum temperature is used for charging and battery pack fan control.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 245
BATTERY PACK TEMPERATURE SENSOR #4 OPEN/SHORT TO B+


Using the Scan tool, view malfunction history.
Is more than one temperature DTC set?
No
System will function properly with one failed sensor.
Yes
Is DTC current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Remove battery pack.
CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.
• Disconnect gray *32-way BPM J2 connector (the one closest to the front of the BP).
• Measure resistance between pins 25 and 29 of the BPM harness connector.
*CAUTION: THE RED 32-WAY CONNECTOR HAS HIGH VOLTAGE TO PREVENT INJURY. DO NOT REMOVE THE RED 32-WAY CONNECTOR.
Is resistance greater than 29K ohms?
No
Terminal tightness or BPM.
Yes
Disconnect the temperature sensor and measure resistance across the sensor (pins A and B).
IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.
Is resistance greater than 29K ohms?
Yes
Battery module temperature sensor.
No
Measure continuity of circuit 204 between sensor and BPM.
Is continuity present?
No
Circuit 204 open.
Yes
Circuit 350 open.

DTC 246 – BATTERY PACK TEMPERATURE SENSOR #4 SHORT TO GROUND


BATTERY PACK
BPM
GRA
32-WAY
TEMPERATURE SENSOR #6 (MODULE 10)
TEMPERATURE SENSOR #5 (MODULE 9)
TEMPERATURE SENSOR #4 (MODULE 6)
TEMPERATURE SENSOR #3 (MODULE 4)
TEMPERATURE SENSOR #2 (MODULE 3)
TEMPERATURE SENSOR #1 (MODULE 1)
A
B
D
G
C
J
H
F
206 GRA
205 LT BLU
204 LT GRN
203 DK GRN
202 PPL
201 PNK
350 WHT
J2 23
J2 22
J2 25
J2 24
J2 27
J2 26
J2 29
5V
TEMP SENSOR #6 INPUT
TEMP SENSOR #5 INPUT
TEMP SENSOR #4 INPUT
TEMP SENSOR #3 INPUT
TEMP SENSOR #2 INPUT
TEMP SENSOR #1 INPUT

PSMELC68200AA

BATTERY PACK TEMPERATURE SENSOR #4 SHORT TO GROUND

There are six temperature sensors located within the battery pack. The temperature sensors are used to determine the temperature of the batteries within the battery pack. This information is used to calculate state of charge (SOC) and to control charging and the battery pack fan. If one of the six sensors fail, the battery pack module (BPM) will use the other remaining five sensors to calculate the battery temperature. The system will operate normally until two or more sensors fail.

DTC PARAMETERS

This DTC will set anytime the BPM sees the resistance of the temperature sensor exceed 548 ohms.

ACTION TAKEN

- The DTC is set and the BPM temperature value will read 65°C (149°F.
- Two or more failed sensors illuminate SERVICE SOON telltale and disable charging.
- Four or more failed sensors BPM substitutes 27°C (81°F) for pack temperature. SOC information could be inaccurate.
- If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

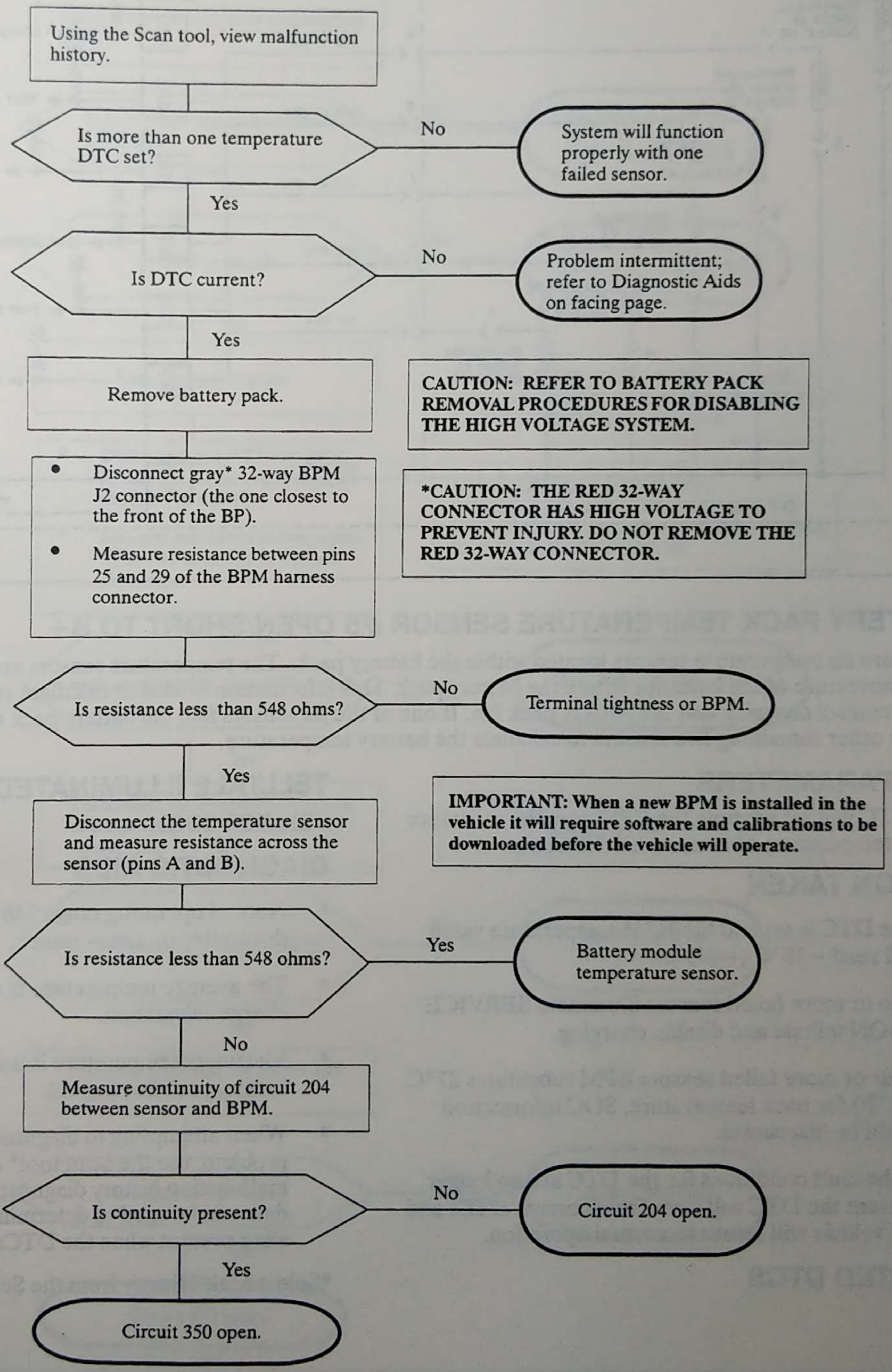
SERVICE SOON

DIAGNOSTIC AIDS

- Normal operating range 548 ohms to 29K ohms depending on temperature.
- The average temperature is used for state of charge calculation.
- Maximum temperature is used for charging and battery pack fan control.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 246
BATTERY PACK TEMPERATURE SENSOR #4 SHORT TO GROUND



Using the Scan tool, view malfunction history.

Is more than one temperature DTC set?

No

System will function properly with one failed sensor.

Yes

Is DTC current?

No

Problem intermittent; refer to Diagnostic Aids on facing page.

Yes

Remove battery pack.

CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.

- Disconnect gray* 32-way BPM J2 connector (the one closest to the front of the BP).
- Measure resistance between pins 25 and 29 of the BPM harness connector.

***CAUTION: THE RED 32-WAY CONNECTOR HAS HIGH VOLTAGE TO PREVENT INJURY. DO NOT REMOVE THE RED 32-WAY CONNECTOR.**

Is resistance less than 548 ohms?

No

Terminal tightness or BPM.

Yes

Disconnect the temperature sensor and measure resistance across the sensor (pins A and B).

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

Is resistance less than 548 ohms?

Yes

Battery module temperature sensor.

No

Measure continuity of circuit 204 between sensor and BPM.

Is continuity present?

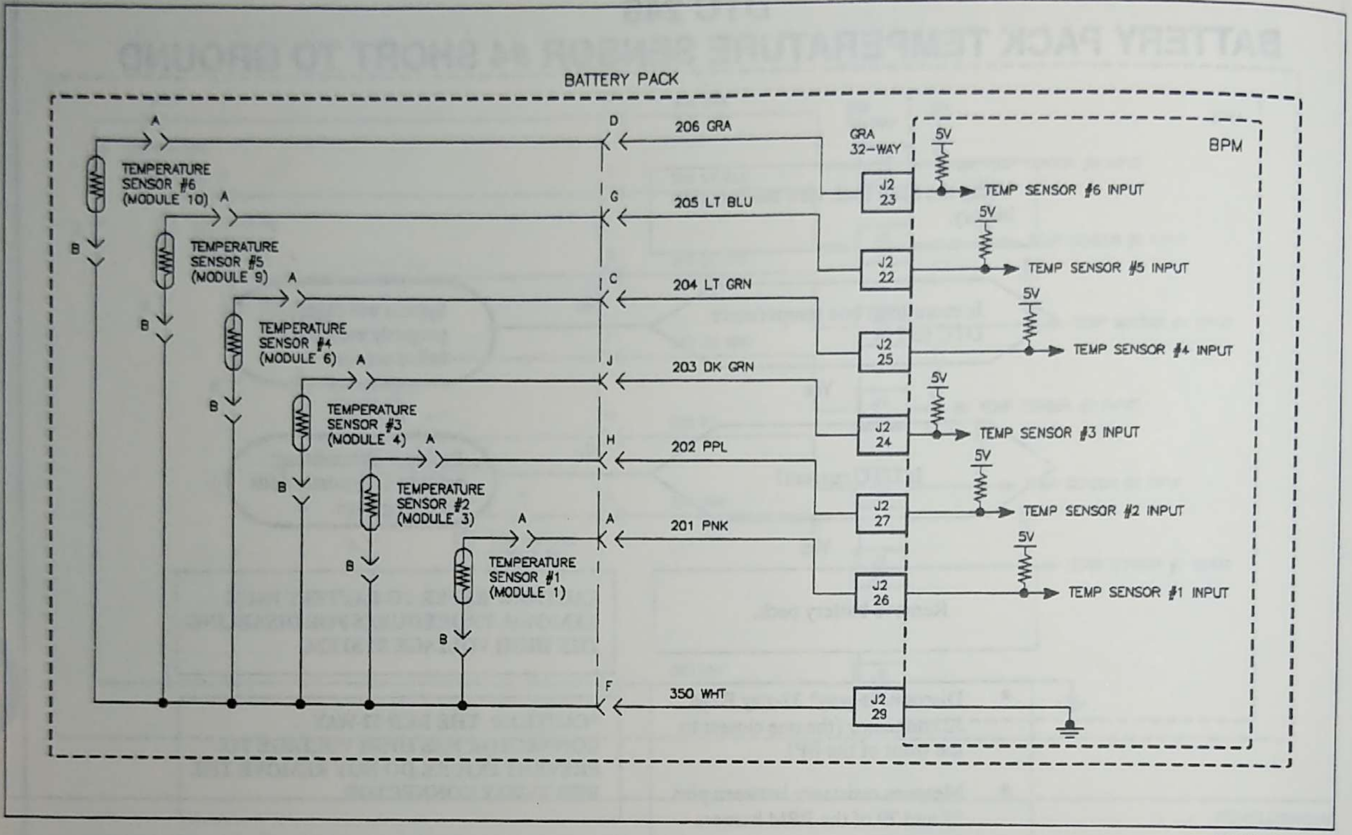
No

Circuit 204 open.

Yes

Circuit 350 open.

DTC 249 – BATTERY PACK TEMPERATURE SENSOR #5 OPEN/SHORT TO B+


BATTERY PACK
BPM
TEMPERATURE SENSOR #6 (MODULE 10)
TEMPERATURE SENSOR #5 (MODULE 9)
TEMPERATURE SENSOR #4 (MODULE 6)
TEMPERATURE SENSOR #3 (MODULE 4)
TEMPERATURE SENSOR #2 (MODULE 3)
TEMPERATURE SENSOR #1 (MODULE 1)
A
B
D
G
C
J
H
A
F
206 GRA
205 LT BLU
204 LT GRN
203 DK GRN
202 PPL
201 PNK
350 WHT
GRA 32-WAY
J2 23
J2 22
J2 25
J2 24
J2 27
J2 26
J2 29
5V
TEMP SENSOR #6 INPUT
TEMP SENSOR #5 INPUT
TEMP SENSOR #4 INPUT
TEMP SENSOR #3 INPUT
TEMP SENSOR #2 INPUT
TEMP SENSOR #1 INPUT

PSMELC68200AA

BATTERY PACK TEMPERATURE SENSOR #5 OPEN/SHORT TO B+

There are six temperature sensors located within the battery pack. The temperature sensors are used to determine the temperature of the batteries within the battery pack. This information is used to calculate state of charge (SOC) and to control charging and the battery pack fan. If one of the six sensors fail, the battery pack module (BPM) will use the other remaining five sensors to calculate the battery temperature.

DTC PARAMETERS

This DTC will set anytime the BPM sees the resistance of the temperature sensor exceed 548 ohms.

ACTION TAKEN

- The DTC is set and the BPM temperature value will read −19°C (−2°F).
- Two or more failed sensors illuminate SERVICE SOON telltale and disable charging.
- Four or more failed sensors BPM substitutes 27°C (81°F) for pack temperature. SOC information could be inaccurate.
- If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

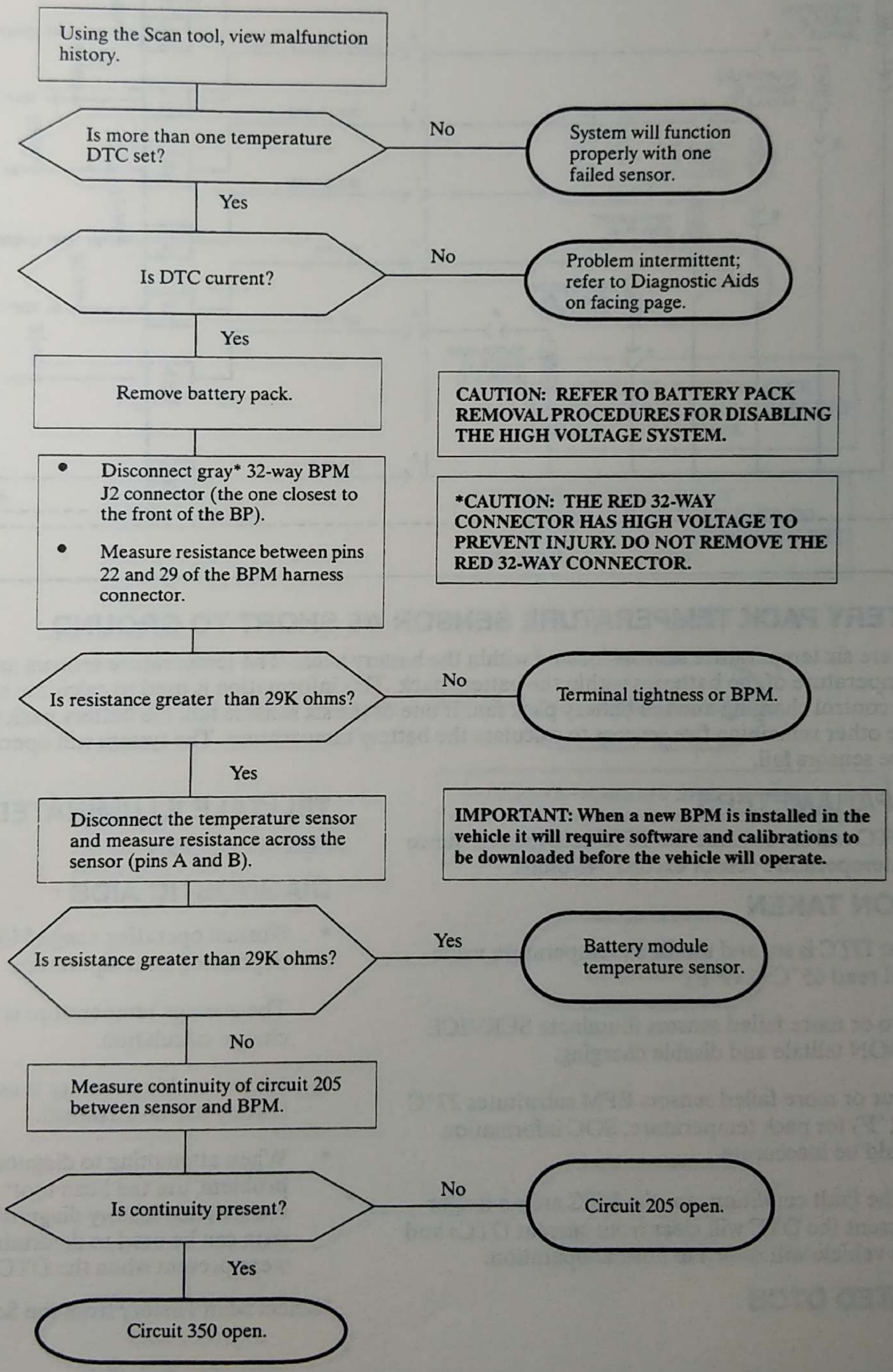
- Normal operating range 548 ohms to 29K ohms depending on temperature.
- The average temperature is used for state of charge calculation.
- Maximum temperature is used for charging and battery pack fan control.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

CS CamScanner

DTC 249

BATTERY PACK TEMPERATURE SENSOR #5 OPEN/SHORT TO B+

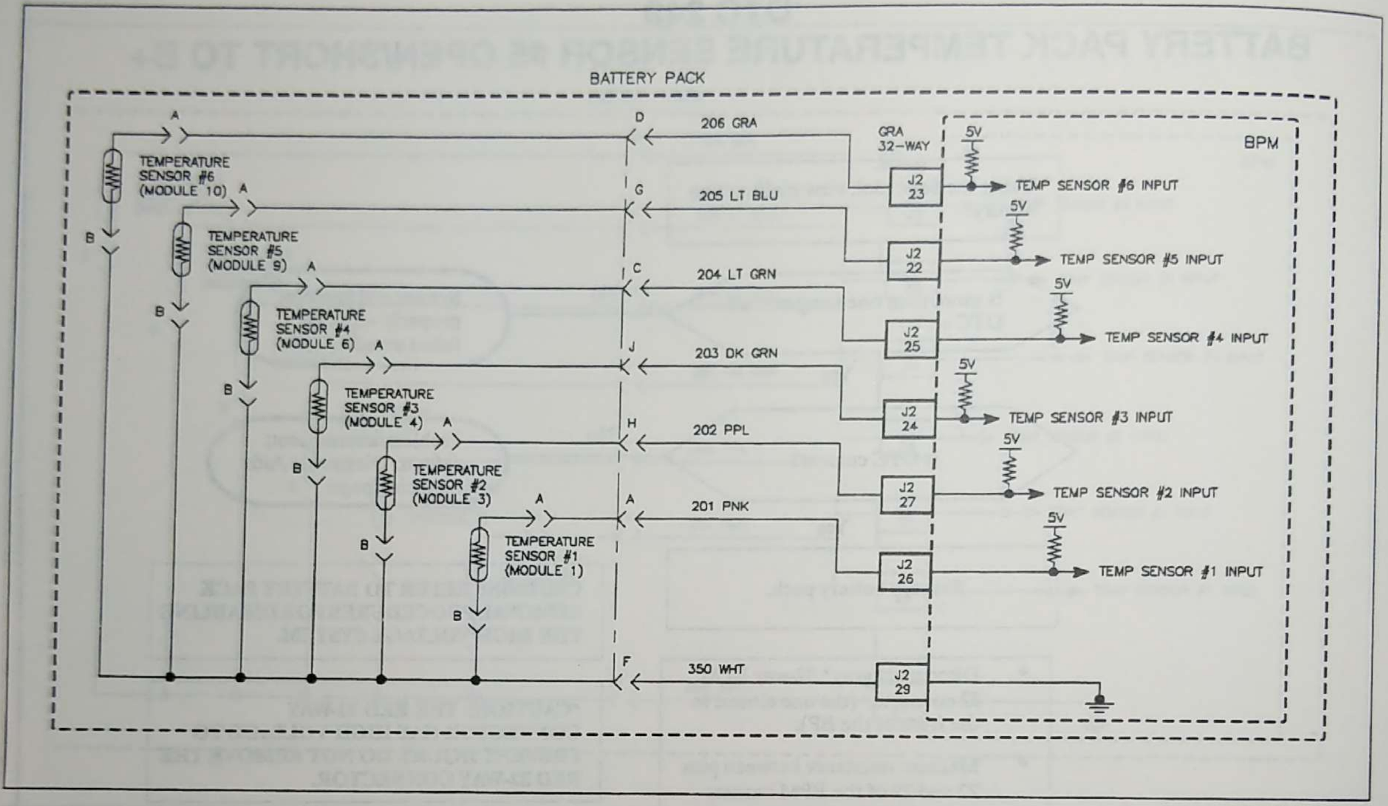

Using the Scan tool, view malfunction history.
Is more than one temperature DTC set?
No
System will function properly with one failed sensor.
Yes
Is DTC current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Remove battery pack.
• Disconnect gray* 32-way BPM J2 connector (the one closest to the front of the BP).
• Measure resistance between pins 22 and 29 of the BPM harness connector.
Is resistance greater than 29K ohms?
No
Terminal tightness or BPM.
Yes
Disconnect the temperature sensor and measure resistance across the sensor (pins A and B).
Is resistance greater than 29K ohms?
Yes
Battery module temperature sensor.
No
Measure continuity of circuit 205 between sensor and BPM.
Is continuity present?
No
Circuit 205 open.
Yes
Circuit 350 open.

CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.

***CAUTION: THE RED 32-WAY CONNECTOR HAS HIGH VOLTAGE TO PREVENT INJURY. DO NOT REMOVE THE RED 32-WAY CONNECTOR.**

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 250 – BATTERY PACK TEMPERATURE SENSOR #5 SHORT TO GROUND


BATTERY PACK
BPM
GRA
32–WAY
TEMPERATURE SENSOR #6 (MODULE 10)
TEMPERATURE SENSOR #5 (MODULE 9)
TEMPERATURE SENSOR #4 (MODULE 6)
TEMPERATURE SENSOR #3 (MODULE 4)
TEMPERATURE SENSOR #2 (MODULE 3)
TEMPERATURE SENSOR #1 (MODULE 1)
A
B
D
G
C
J
H
F
206 GRA
205 LT BLU
204 LT GRN
203 DK GRN
202 PPL
201 PNK
350 WHT
J2 23
J2 22
J2 25
J2 24
J2 27
J2 26
J2 29
5V
TEMP SENSOR #6 INPUT
TEMP SENSOR #5 INPUT
TEMP SENSOR #4 INPUT
TEMP SENSOR #3 INPUT
TEMP SENSOR #2 INPUT
TEMP SENSOR #1 INPUT

PSMELC68200AA

BATTERY PACK TEMPERATURE SENSOR #5 SHORT TO GROUND

There are six temperature sensors located within the battery pack. The temperature sensors are used to determine the temperature of the batteries within the battery pack. This information is used to calculate state of charge (SOC) and to control charging and the battery pack fan. If one of the six sensors fail, the battery pack module (BPM) will use the other remaining five sensors to calculate the battery temperature. The system will operate normally until two or more sensors fail.

DTC PARAMETERS

This DTC will set anytime the BPM sees the resistance of the temperature sensor exceed 548 ohms.

ACTION TAKEN

- The DTC is set and the BPM temperature value will read 65°C (149°F).
- Two or more failed sensors illuminate SERVICE SOON telltale and disable charging.
- Four or more failed sensors BPM substitutes 27°C (81°F) for pack temperature. SOC information could be inaccurate.
- If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

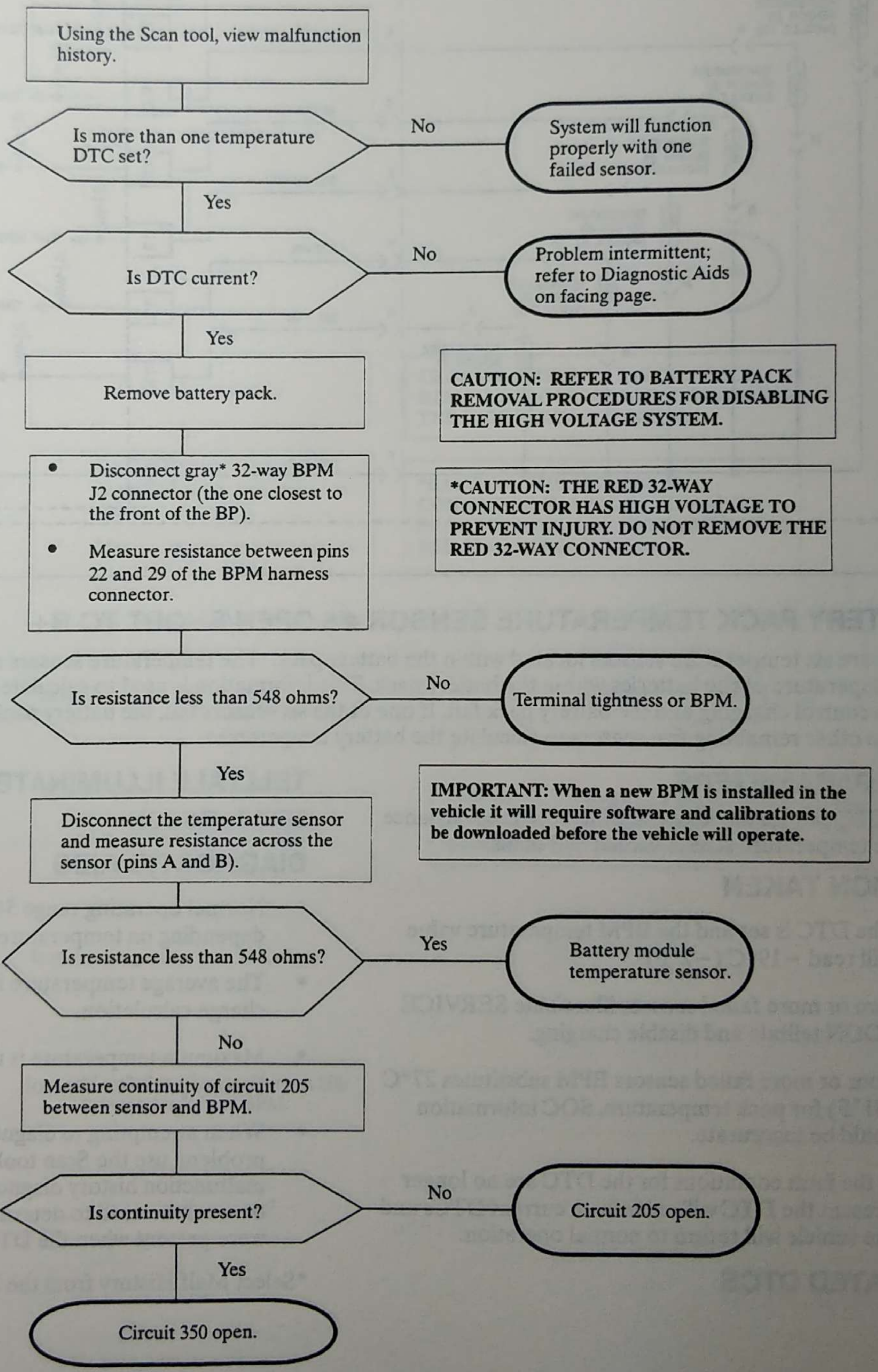
SERVICE SOON

DIAGNOSTIC AIDS

- Normal operating range 548 ohms to 29K ohms depending on temperature.
- The average temperature is used for state of charge calculation.
- Maximum temperature is used for charging and battery pack fan control.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 250
BATTERY PACK TEMPERATURE SENSOR #5 SHORT TO GROUND

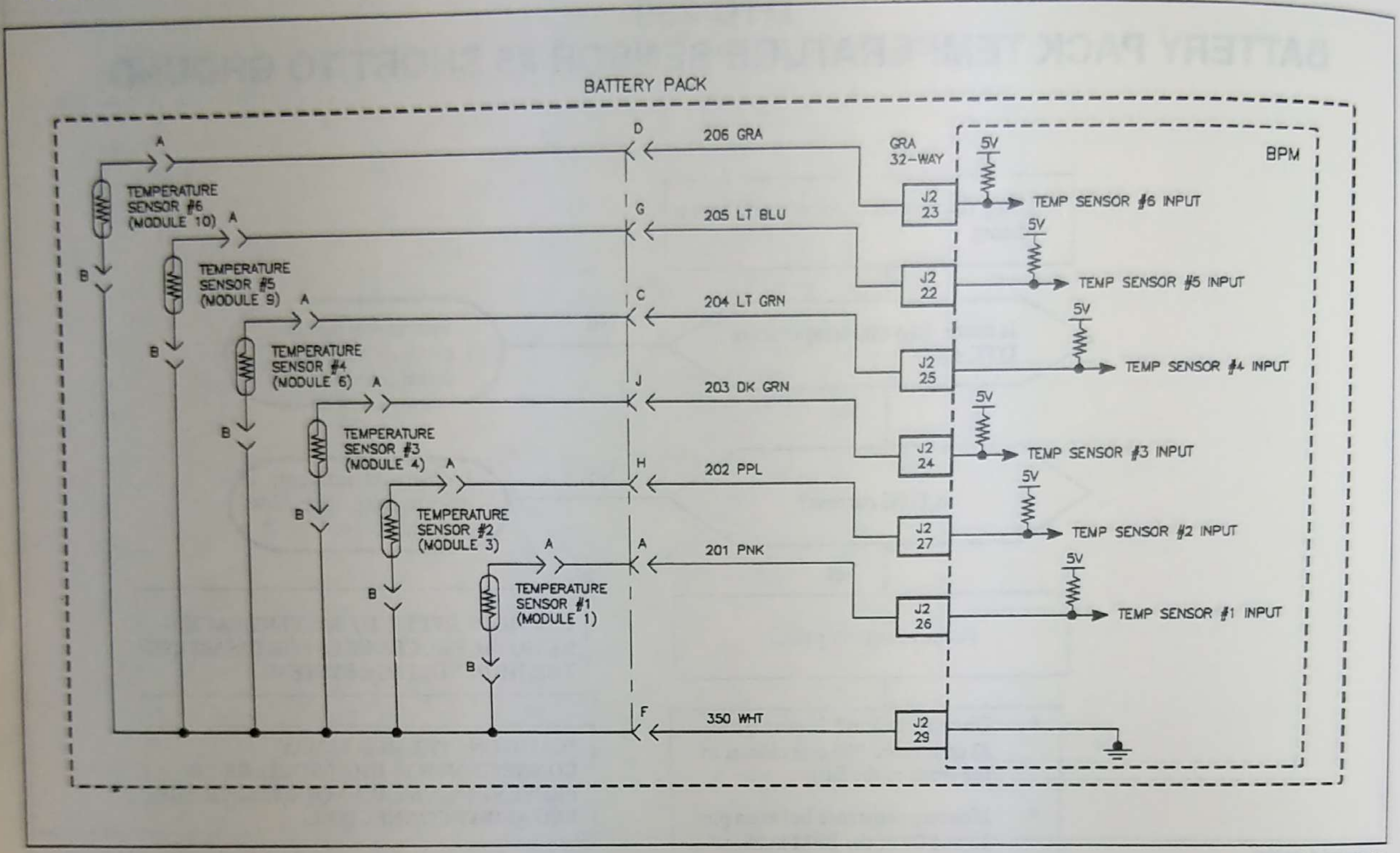

Using the Scan tool, view malfunction history.
Is more than one temperature DTC set?
No
System will function properly with one failed sensor.
Yes
Is DTC current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Remove battery pack.
Disconnect gray* 32-way BPM J2 connector (the one closest to the front of the BP).
Measure resistance between pins 22 and 29 of the BPM harness connector.
Is resistance less than 548 ohms?
No
Terminal tightness or BPM.
Yes
Disconnect the temperature sensor and measure resistance across the sensor (pins A and B).
Is resistance less than 548 ohms?
Yes
Battery module temperature sensor.
No
Measure continuity of circuit 205 between sensor and BPM.
Is continuity present?
No
Circuit 205 open.
Yes
Circuit 350 open.

CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.

***CAUTION: THE RED 32-WAY CONNECTOR HAS HIGH VOLTAGE TO PREVENT INJURY. DO NOT REMOVE THE RED 32-WAY CONNECTOR.**

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 253 – BATTERY PACK TEMPERATURE SENSOR #6 OPEN/SHORT TO B+


BATTERY PACK
TEMPERATURE SENSOR #6 (MODULE 10)
TEMPERATURE SENSOR #5 (MODULE 9)
TEMPERATURE SENSOR #4 (MODULE 6)
TEMPERATURE SENSOR #3 (MODULE 4)
TEMPERATURE SENSOR #2 (MODULE 3)
TEMPERATURE SENSOR #1 (MODULE 1)
A
B
D
G
C
J
H
F
206 GRA
205 LT BLU
204 LT GRN
203 DK GRN
202 PPL
201 PNK
350 WHT
GRA 32-WAY
J2 23
J2 22
J2 25
J2 24
J2 27
J2 26
J2 29
5V
BPM
TEMP SENSOR #6 INPUT
TEMP SENSOR #5 INPUT
TEMP SENSOR #4 INPUT
TEMP SENSOR #3 INPUT
TEMP SENSOR #2 INPUT
TEMP SENSOR #1 INPUT

PSMELC68200AA

BATTERY PACK TEMPERATURE SENSOR #6 OPEN/SHORT TO B+

There are six temperature sensors located within the battery pack. The temperature sensors are used to determine the temperature of the batteries within the battery pack. This information is used to calculate state of charge (SOC) and to control charging and the battery pack fan. If one of the six sensors fail, the battery pack module (BPM) will use the other remaining five sensors to calculate the battery temperature.

DTC PARAMETERS

This DTC will set anytime the BPM sees the resistance of the temperature sensor exceed 548 ohms.

ACTION TAKEN

- The DTC is set and the BPM temperature value will read −19°C (−2°F).
- Two or more failed sensors illuminate SERVICE SOON telltale and disable charging.
- Four or more failed sensors BPM substitutes 27°C (81°F) for pack temperature. SOC information could be inaccurate.
- If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

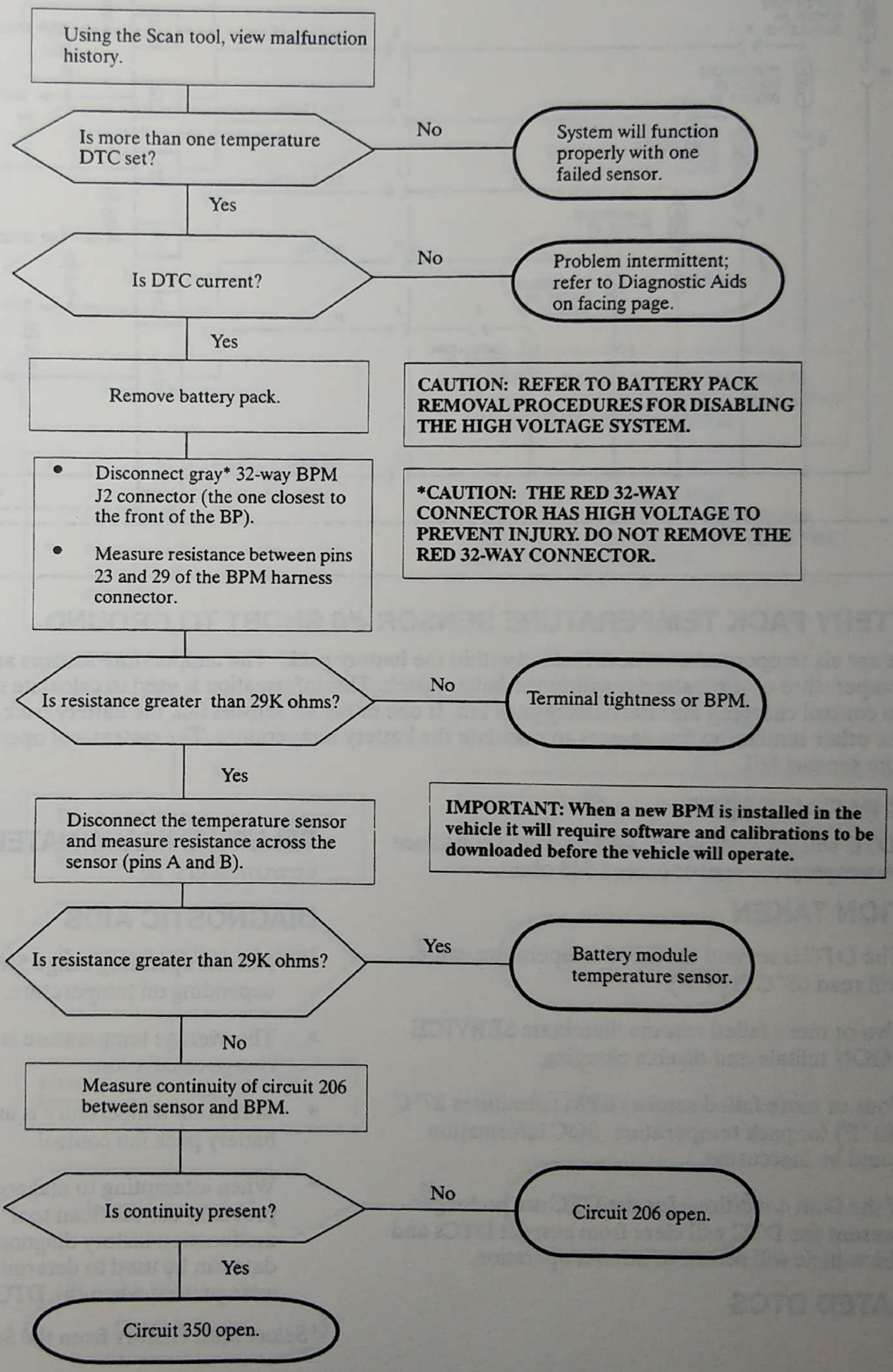
SERVICE SOON

DIAGNOSTIC AIDS

- Normal operating range 548 ohms to 29K ohms depending on temperature.
- The average temperature is used for state of charge calculation.
- Maximum temperature is used for charging and battery pack fan control.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 253
BATTERY PACK TEMPERATURE SENSOR #6 OPEN/SHORT TO B+

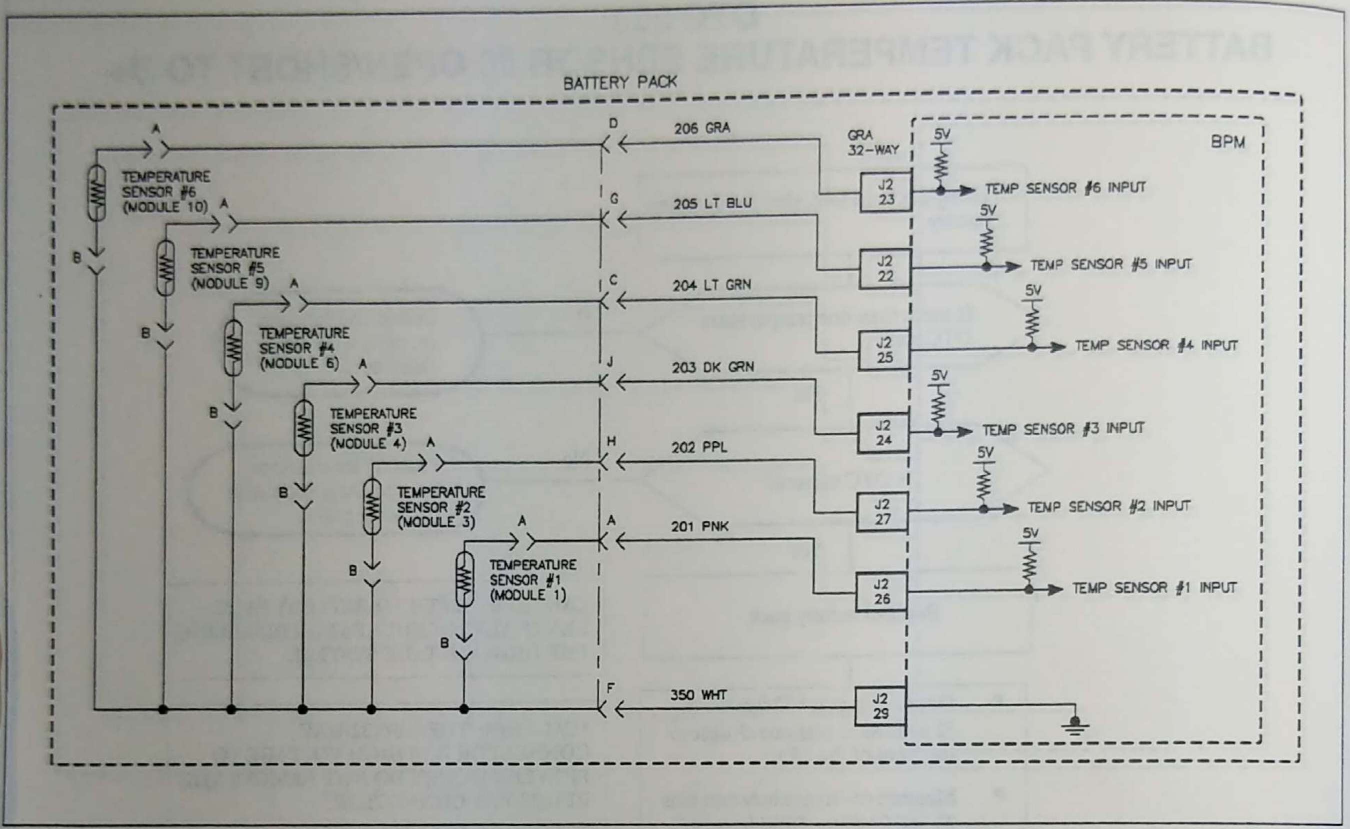

Using the Scan tool, view malfunction history.
Is more than one temperature DTC set?
No
System will function properly with one failed sensor.
Yes
Is DTC current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Remove battery pack.
Disconnect gray* 32-way BPM J2 connector (the one closest to the front of the BP).
Measure resistance between pins 23 and 29 of the BPM harness connector.
Is resistance greater than 29K ohms?
No
Terminal tightness or BPM.
Yes
Disconnect the temperature sensor and measure resistance across the sensor (pins A and B).
Is resistance greater than 29K ohms?
Yes
Battery module temperature sensor.
No
Measure continuity of circuit 206 between sensor and BPM.
Is continuity present?
No
Circuit 206 open.
Yes
Circuit 350 open.

CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.

***CAUTION: THE RED 32-WAY CONNECTOR HAS HIGH VOLTAGE TO PREVENT INJURY. DO NOT REMOVE THE RED 32-WAY CONNECTOR.**

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 254 – BATTERY PACK TEMPERATURE SENSOR #6 SHORT TO GROUND


BATTERY PACK
TEMPERATURE SENSOR #6 (MODULE 10)
TEMPERATURE SENSOR #5 (MODULE 9)
TEMPERATURE SENSOR #4 (MODULE 6)
TEMPERATURE SENSOR #3 (MODULE 4)
TEMPERATURE SENSOR #2 (MODULE 3)
TEMPERATURE SENSOR #1 (MODULE 1)
A
B
D
G
C
J
H
F
206 GRA
205 LT BLU
204 LT GRN
203 DK GRN
202 PPL
201 PNK
350 WHT
GRA 32-WAY
BPM
5V
J2 23
J2 22
J2 25
J2 24
J2 27
J2 26
J2 29
TEMP SENSOR #6 INPUT
TEMP SENSOR #5 INPUT
TEMP SENSOR #4 INPUT
TEMP SENSOR #3 INPUT
TEMP SENSOR #2 INPUT
TEMP SENSOR #1 INPUT

PSMELC68200AA

BATTERY PACK TEMPERATURE SENSOR #6 SHORT TO GROUND

There are six temperature sensors located within the battery pack. The temperature sensors are used to determine the temperature of the batteries within the battery pack. This information is used to calculate state of charge (SOC) and to control charging and the battery pack fan. If one of the six sensors fail, the battery pack module (BPM) will use the other remaining five sensors to calculate the battery temperature. The system will operate normally until two or more sensors fail.

DTC PARAMETERS

This DTC will set anytime the BPM sees the resistance of the temperature sensor exceed 548 ohms.

ACTION TAKEN

- The DTC is set and the BPM temperature value will read 65°C (149°F).
- Two or more failed sensors illuminate SERVICE SOON telltale and disable charging.
- Four or more failed sensors BPM substitutes 27°C (81°F) for pack temperature. SOC information could be inaccurate.
- If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

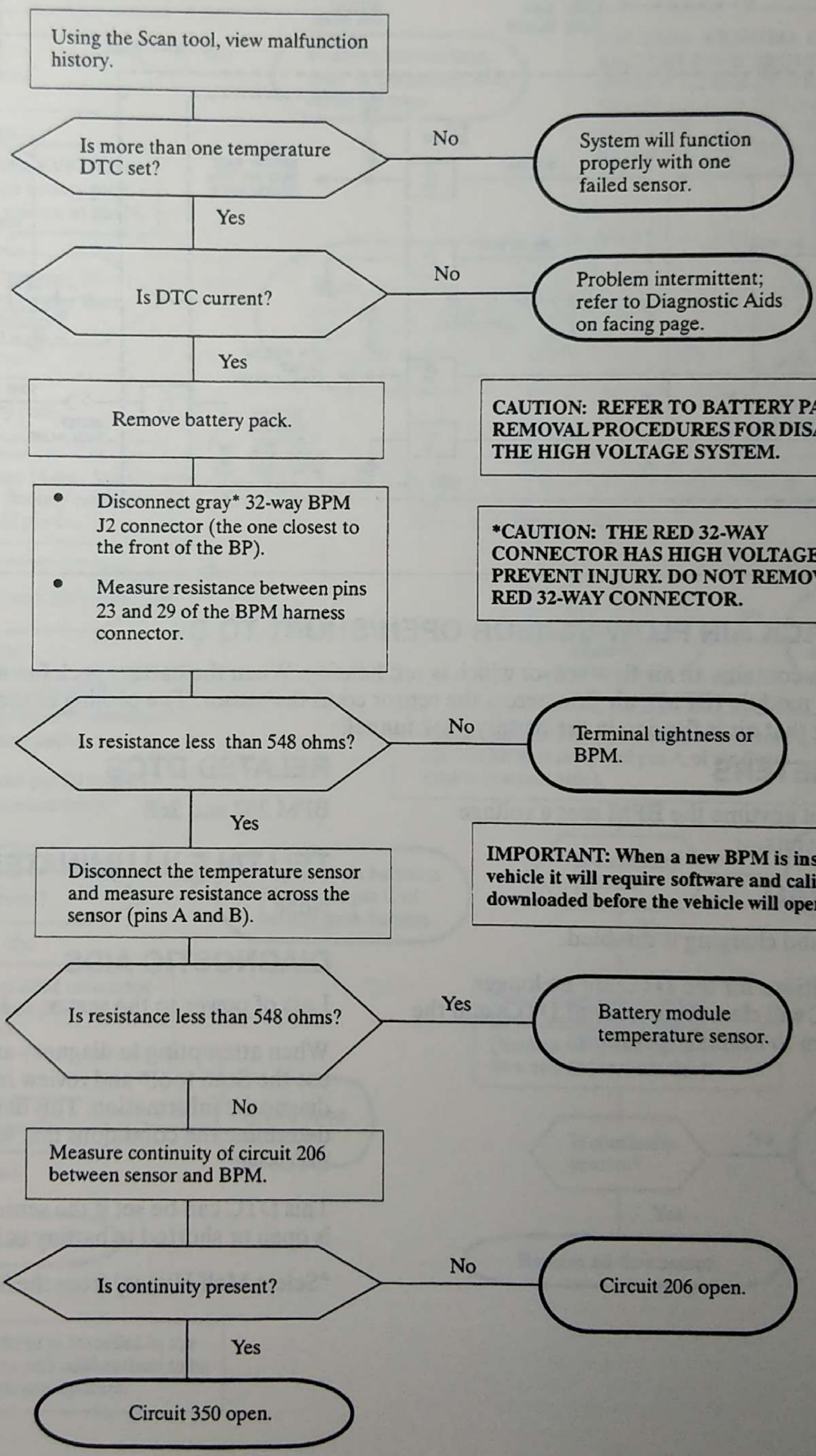
SERVICE SOON

DIAGNOSTIC AIDS

- Normal operating range 548 ohms to 29K ohms depending on temperature.
- The average temperature is used for state of charge calculation.
- Maximum temperature is used for charging and battery pack fan control.
- When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 254
BATTERY PACK TEMPERATURE SENSOR #6 SHORT TO GROUND



Using the Scan tool, view malfunction history.

Is more than one temperature DTC set?

No

System will function properly with one failed sensor.

Yes

Is DTC current?

No

Problem intermittent; refer to Diagnostic Aids on facing page.

Yes

Remove battery pack.

- Disconnect gray* 32-way BPM J2 connector (the one closest to the front of the BP).
- Measure resistance between pins 23 and 29 of the BPM harness connector.

Is resistance less than 548 ohms?

No

Terminal tightness or BPM.

Yes

Disconnect the temperature sensor and measure resistance across the sensor (pins A and B).

Is resistance less than 548 ohms?

Yes

Battery module temperature sensor.

No

Measure continuity of circuit 206 between sensor and BPM.

Is continuity present?

No

Circuit 206 open.

Yes

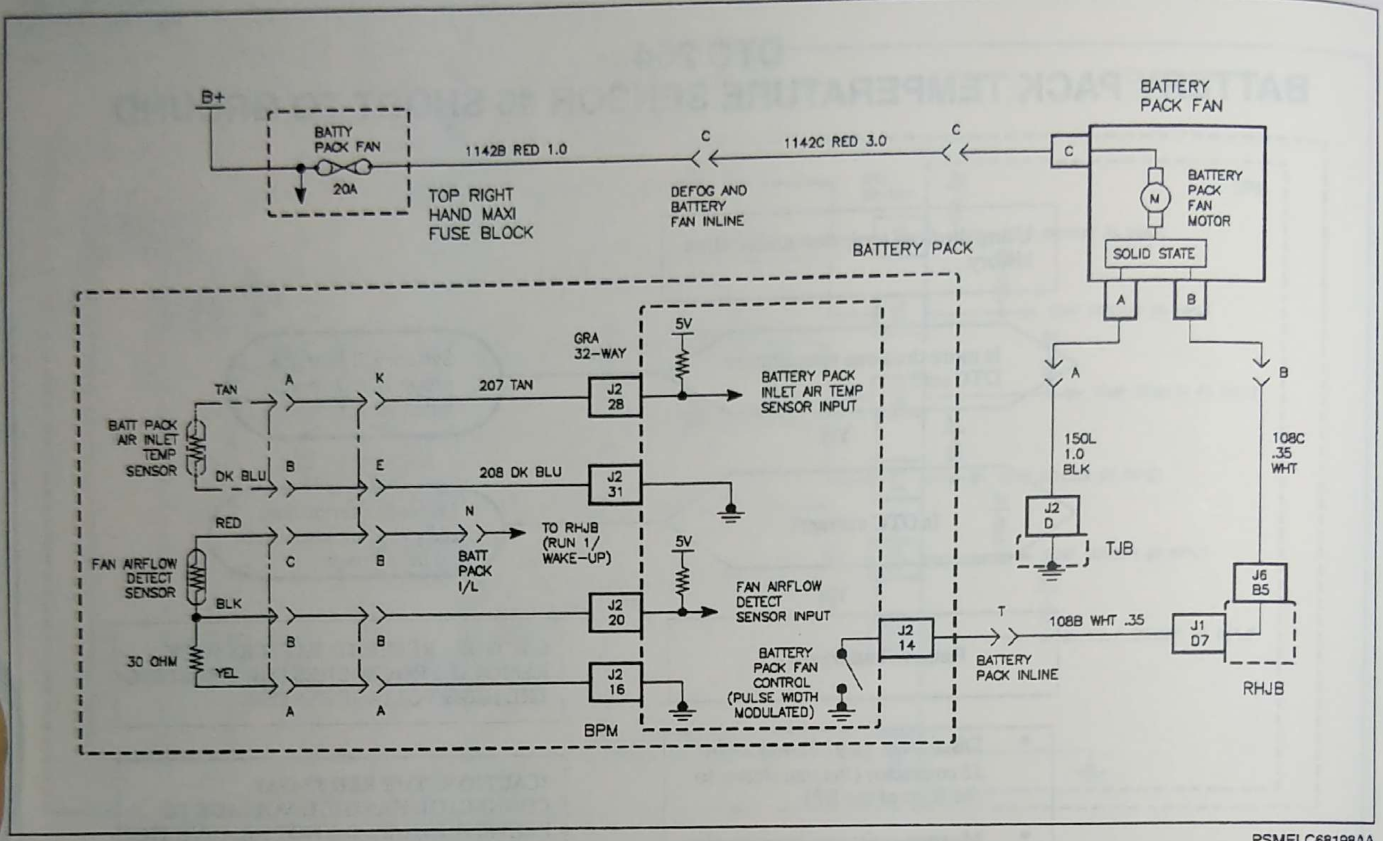
Circuit 350 open.

CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.

***CAUTION: THE RED 32-WAY CONNECTOR HAS HIGH VOLTAGE TO PREVENT INJURY. DO NOT REMOVE THE RED 32-WAY CONNECTOR.**

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 257 – BATTERY PACK AIR FLOW SENSOR OPEN/SHORT TO B+


B+
BATT'Y PACK FAN
20A
1142B RED 1.0
TOP RIGHT HAND MAXI FUSE BLOCK
C
DEFOG AND BATTERY FAN INLINE
1142C RED 3.0
C
BATTERY PACK FAN
C
BATTERY PACK FAN MOTOR
M
SOLID STATE
A
B
BATTERY PACK
GRA 32-WAY
5V
TAN
A
K
207 TAN
J2 28
BATTERY PACK INLET AIR TEMP SENSOR INPUT
BATT PACK AIR INLET TEMP SENSOR
DK BLU
B
E
208 DK BLU
J2 31
RED
N
TO RHJB (RUN 1/ WAKE-UP)
BATT PACK I/L
FAN AIRFLOW DETECT SENSOR
C
B
5V
BLK
J2 20
FAN AIRFLOW DETECT SENSOR INPUT
B
B
30 OHM
YEL
J2 16
A
A
BPM
BATTERY PACK FAN CONTROL (PULSE WIDTH MODULATED)
J2 14
T
1088 WHT .35
BATTERY PACK INLINE
J1 D7
RHJB
J6 B5
108C .35 WHT
A
B
150L 1.0 BLK
J2 D
TJB

PSMELC68198AA

BATTERY PACK AIR FLOW SENSOR OPEN/SHORT TO B+

The battery pack contains an air flow sensor which is self heating. When the battery pack fan is commanded On by the battery pack module (BPM), air flow across the sensor cools the sensor. The cooling of the sensor drops the voltage verifying that air is flowing in the battery pack tunnel.

DTC PARAMETERS

This DTC will set anytime the BPM sees a voltage greater than 4.5 volts.

ACTION TAKEN

The DTC is set and charging is disabled.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 267 and 268

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

Loss of power to the sensor = 100% air flow.

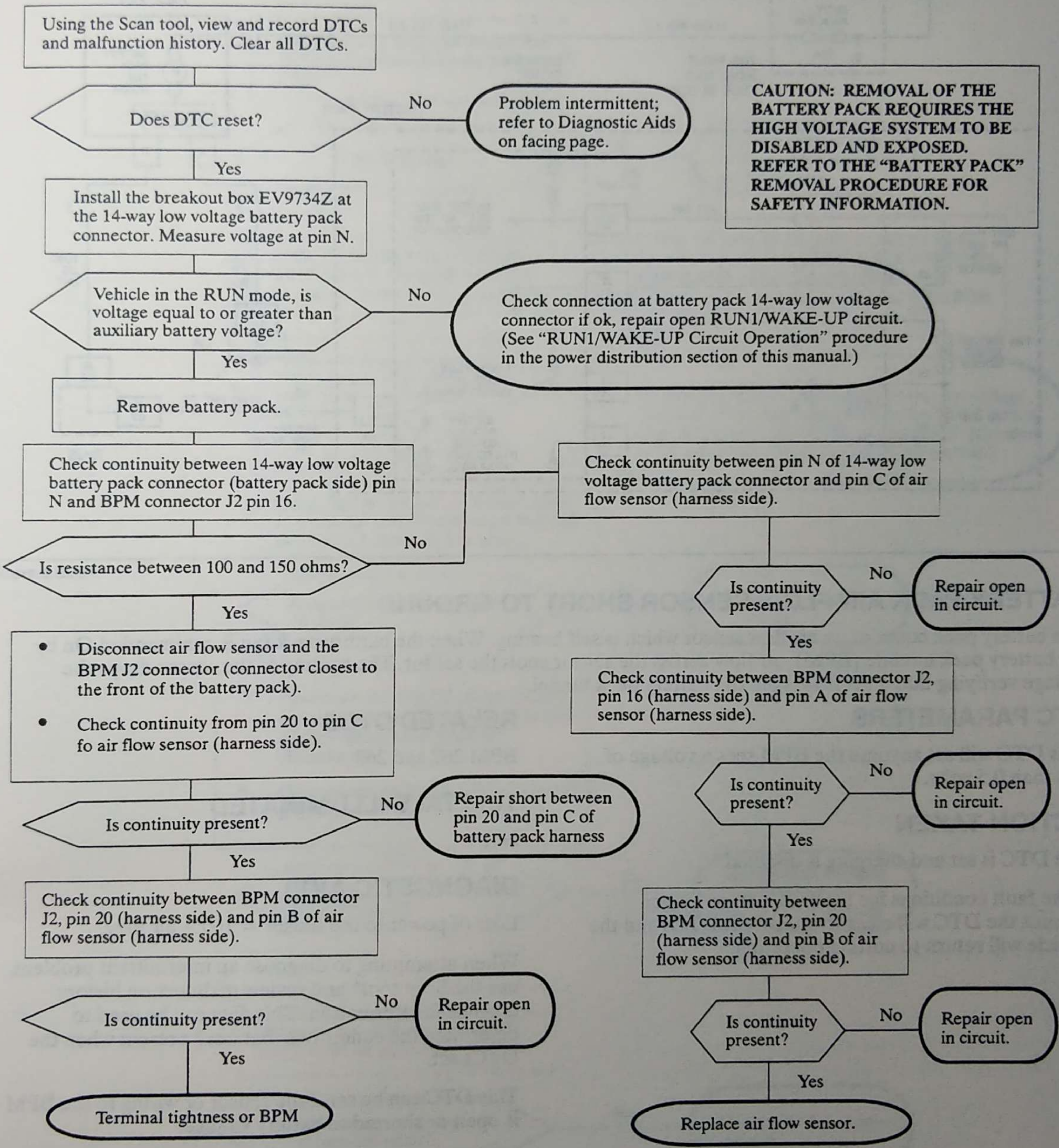
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

This DTC can be set if the sensor or wiring to the BPM is open or shorted to battery voltage.

*Select Malf History from the Scan tool BPM menu.

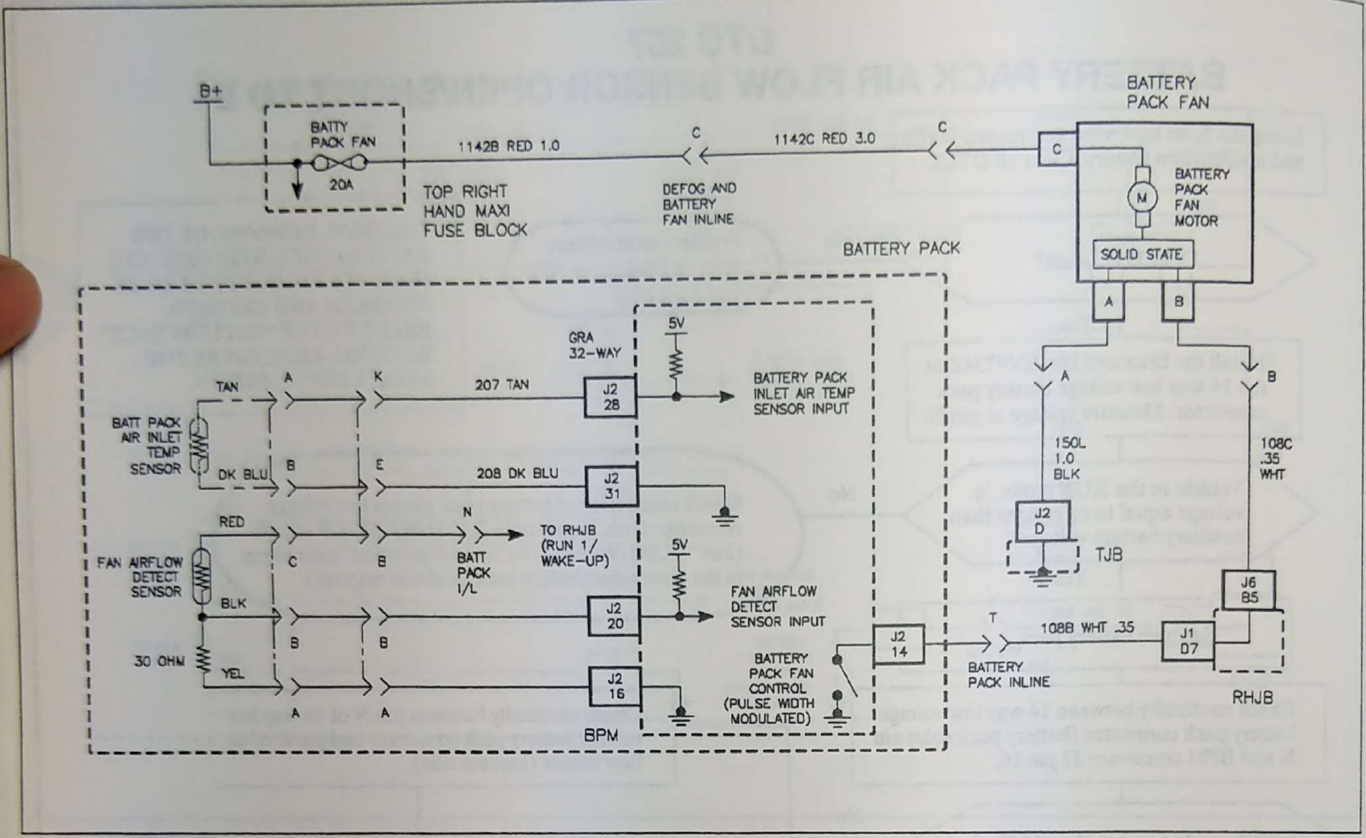
DTC 257
BATTERY PACK AIR FLOW SENSOR OPEN/SHORT TO B+

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.


Using the Scan tool, view and record DTCs and malfunction history. Clear all DTCs.
Does DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Install the breakout box EV9734Z at the 14-way low voltage battery pack connector. Measure voltage at pin N.
Vehicle in the RUN mode, is voltage equal to or greater than auxiliary battery voltage?
No
Check connection at battery pack 14-way low voltage connector if ok, repair open RUN1/WAKE-UP circuit. (See "RUN1/WAKE-UP Circuit Operation" procedure in the power distribution section of this manual.)
Yes
Remove battery pack.
Check continuity between 14-way low voltage battery pack connector (battery pack side) pin N and BPM connector J2 pin 16.
Is resistance between 100 and 150 ohms?
No
Check continuity between pin N of 14-way low voltage battery pack connector and pin C of air flow sensor (harness side).
Is continuity present?
No
Repair open in circuit.
Yes
Check continuity between BPM connector J2, pin 16 (harness side) and pin A of air flow sensor (harness side).
Is continuity present?
No
Repair open in circuit.
Yes
Check continuity between BPM connector J2, pin 20 (harness side) and pin B of air flow sensor (harness side).
Is continuity present?
No
Repair open in circuit.
Yes
Replace air flow sensor.
Yes
• Disconnect air flow sensor and the BPM J2 connector (connector closest to the front of the battery pack).
• Check continuity from pin 20 to pin C fo air flow sensor (harness side).
Is continuity present?
No
Repair short between pin 20 and pin C of battery pack harness
Yes
Check continuity between BPM connector J2, pin 20 (harness side) and pin B of air flow sensor (harness side).
Is continuity present?
No
Repair open in circuit.
Yes
Terminal tightness or BPM

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 258 – BATTERY PACK AIR FLOW SENSOR SHORT TO GROUND


B+
BATTY PACK FAN
20A
1142B RED 1.0
C
1142C RED 3.0
C
BATTERY PACK FAN
C
BATTERY PACK FAN MOTOR
M
SOLID STATE
A
B
TOP RIGHT HAND MAXI FUSE BLOCK
DEFOG AND BATTERY FAN INLINE
BATTERY PACK
GRA 32-WAY
5V
TAN
A
K
207 TAN
J2 28
BATTERY PACK INLET AIR TEMP SENSOR INPUT
BATT PACK AIR INLET TEMP SENSOR
DK BLU
B
E
208 DK BLU
J2 31
RED
N
TO RHJB (RUN 1/ WAKE-UP)
FAN AIRFLOW DETECT SENSOR
C
B
BATT PACK I/L
5V
BLK
J2 20
FAN AIRFLOW DETECT SENSOR INPUT
B
B
30 OHM
YEL
J2 16
A
A
BPM
BATTERY PACK FAN CONTROL (PULSE WIDTH MODULATED)
J2 14
T
1088 WHT .35
J1 D7
BATTERY PACK INLINE
A
150L 1.0 BLK
J2 D
TJB
B
108C .35 WHT
J6 B5
RHJB

PSMELC68198AA

BATTERY PACK AIR FLOW SENSOR SHORT TO GROUND

The battery pack contains an air flow sensor which is self heating. When the battery pack fan is commanded On by the battery pack module (BPM), air flow across the sensor cools the sensor. The cooling of the sensor drops the voltage verifying that air is flowing in the battery pack tunnel.

DTC PARAMETERS

This DTC will set anytime the BPM sees a voltage of less than 0.5 volts.

ACTION TAKEN

The DTC is set and charging is disabled.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 267 and 268

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

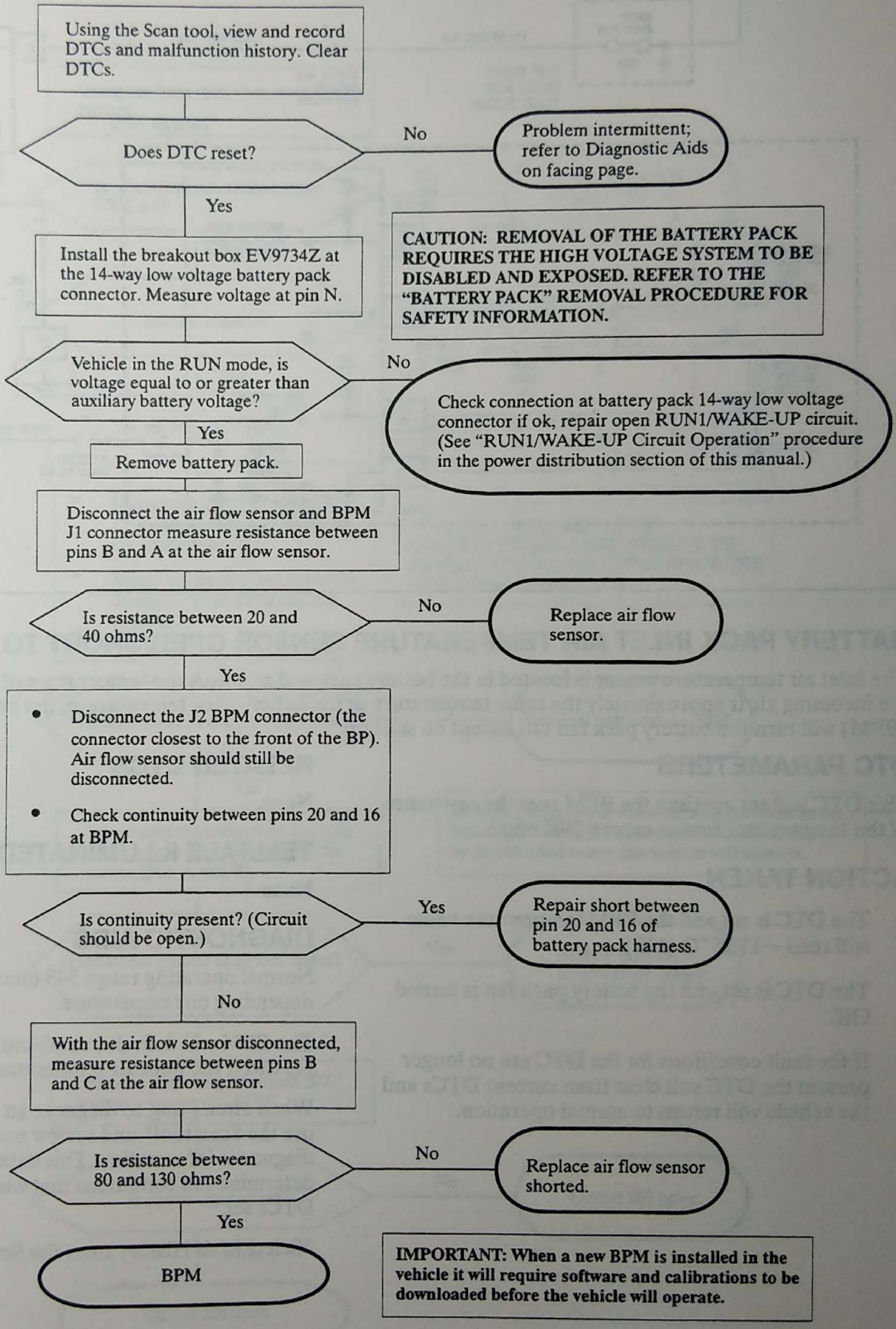
Loss of power to the sensor = 100% air flow.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

This DTC can be set if the sensor or wiring to the BPM is open or shorted to battery voltage.

*Select Malf History from the Scan tool BPM menu.

DTC 258
BATTERY PACK AIR FLOW SENSOR SHORT TO GROUND



Using the Scan tool, view and record DTCs and malfunction history. Clear DTCs.

Does DTC reset?

Problem intermittent; refer to Diagnostic Aids on facing page.

Install the breakout box EV9734Z at the 14-way low voltage battery pack connector. Measure voltage at pin N.

CAUTION: REMOVAL OF THE BATTERY PACK REQUIRES THE HIGH VOLTAGE SYSTEM TO BE DISABLED AND EXPOSED. REFER TO THE "BATTERY PACK" REMOVAL PROCEDURE FOR SAFETY INFORMATION.

Vehicle in the RUN mode, is voltage equal to or greater than auxiliary battery voltage?

Check connection at battery pack 14-way low voltage connector if ok, repair open RUN1/WAKE-UP circuit. (See "RUN1/WAKE-UP Circuit Operation" procedure in the power distribution section of this manual.)

Remove battery pack.

Disconnect the air flow sensor and BPM J1 connector measure resistance between pins B and A at the air flow sensor.

Is resistance between 20 and 40 ohms?

Replace air flow sensor.

- Disconnect the J2 BPM connector (the connector closest to the front of the BP). Air flow sensor should still be disconnected.
- Check continuity between pins 20 and 16 at BPM.

Is continuity present? (Circuit should be open.)

Repair short between pin 20 and 16 of battery pack harness.

With the air flow sensor disconnected, measure resistance between pins B and C at the air flow sensor.

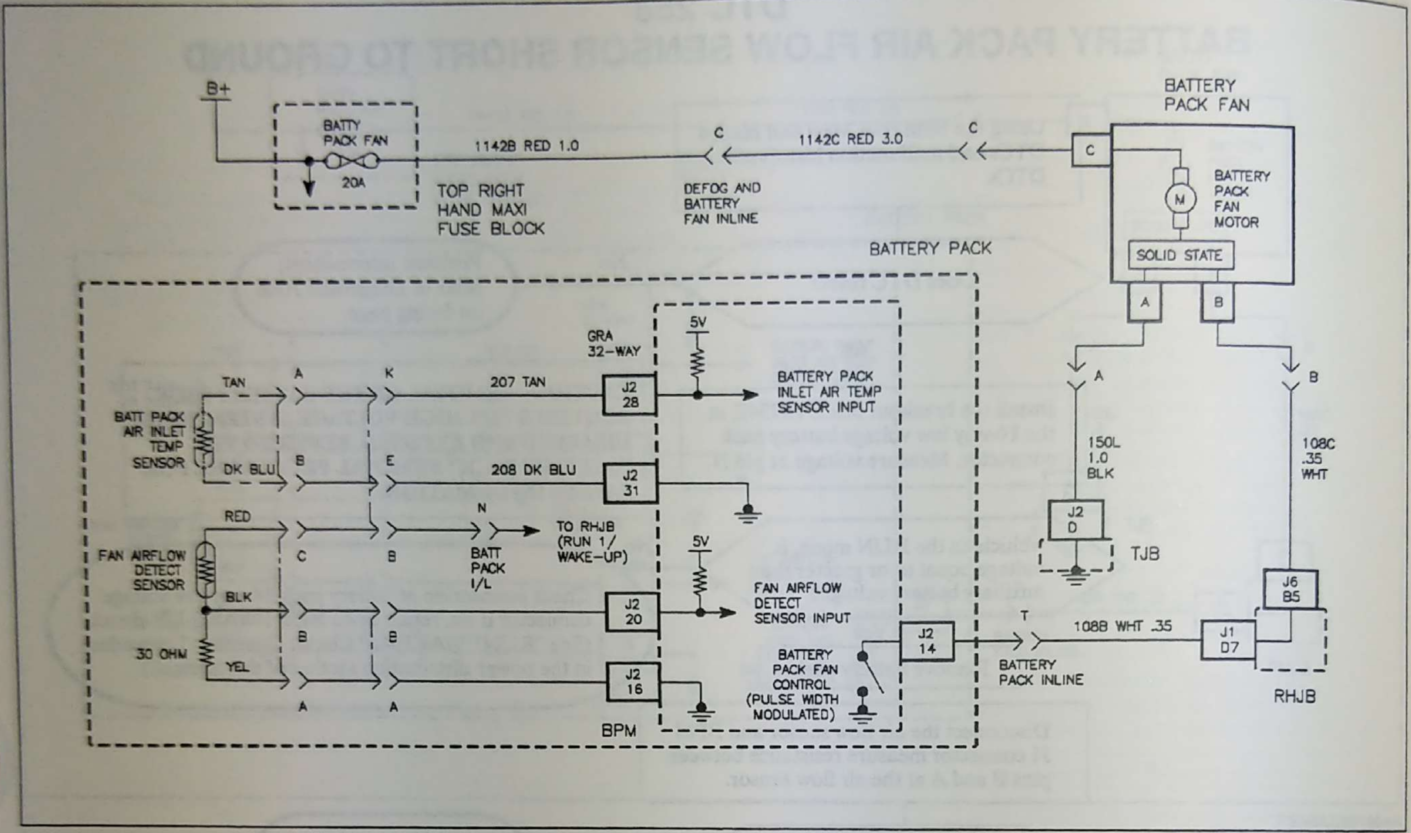
Is resistance between 80 and 130 ohms?

Replace air flow sensor shorted.

BPM

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 265 – BATTERY PACK INLET AIR TEMPERATURE SENSOR OPEN/SHORT TO B+


B+
BATTY PACK FAN
20A
1142B RED 1.0
TOP RIGHT HAND MAXI FUSE BLOCK
C
1142C RED 3.0
C
DEFOG AND BATTERY FAN INLINE
BATTERY PACK FAN
C
BATTERY PACK FAN MOTOR
M
SOLID STATE
A
B
BATTERY PACK
GRA 32-WAY
5V
TAN
A
K
207 TAN
J2 28
BATTERY PACK INLET AIR TEMP SENSOR INPUT
BATT PACK AIR INLET TEMP SENSOR
DK BLU
B
E
208 DK BLU
J2 31
RED
N
TO RHJB (RUN 1/ WAKE-UP)
FAN AIRFLOW DETECT SENSOR
C
B
BATT PACK I/L
5V
BLK
J2 20
FAN AIRFLOW DETECT SENSOR INPUT
30 OHM
B
B
YEL
J2 16
A
A
BPM
J2 14
BATTERY PACK FAN CONTROL (PULSE WIDTH MODULATED)
T
BATTERY PACK INLINE
1088 WHT .35
J1 D7
J6 B5
RHJB
A
150L 1.0 BLK
J2 D
TJB
B
108C .35 WHT

PSMELC68198AA

BATTERY PACK INLET AIR TEMPERATURE SENSOR OPEN/SHORT TO B+

The inlet air temperature sensor is located in the battery pack and monitors the temperature of the incoming air. If the incoming air is approximately the same temperature as the battery pack temperature, the battery pack module (BPM) will turn the battery pack fan Off except on start up.

DTC PARAMETERS

This DTC will set anytime the BPM sees the resistance of the temperature sensor exceed 29K ohms.

ACTION TAKEN

- The DTC is set and the BPM temperature value will read −17.25°C (1°F).
- The DTC is set and the battery pack fan is turned Off.
- If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

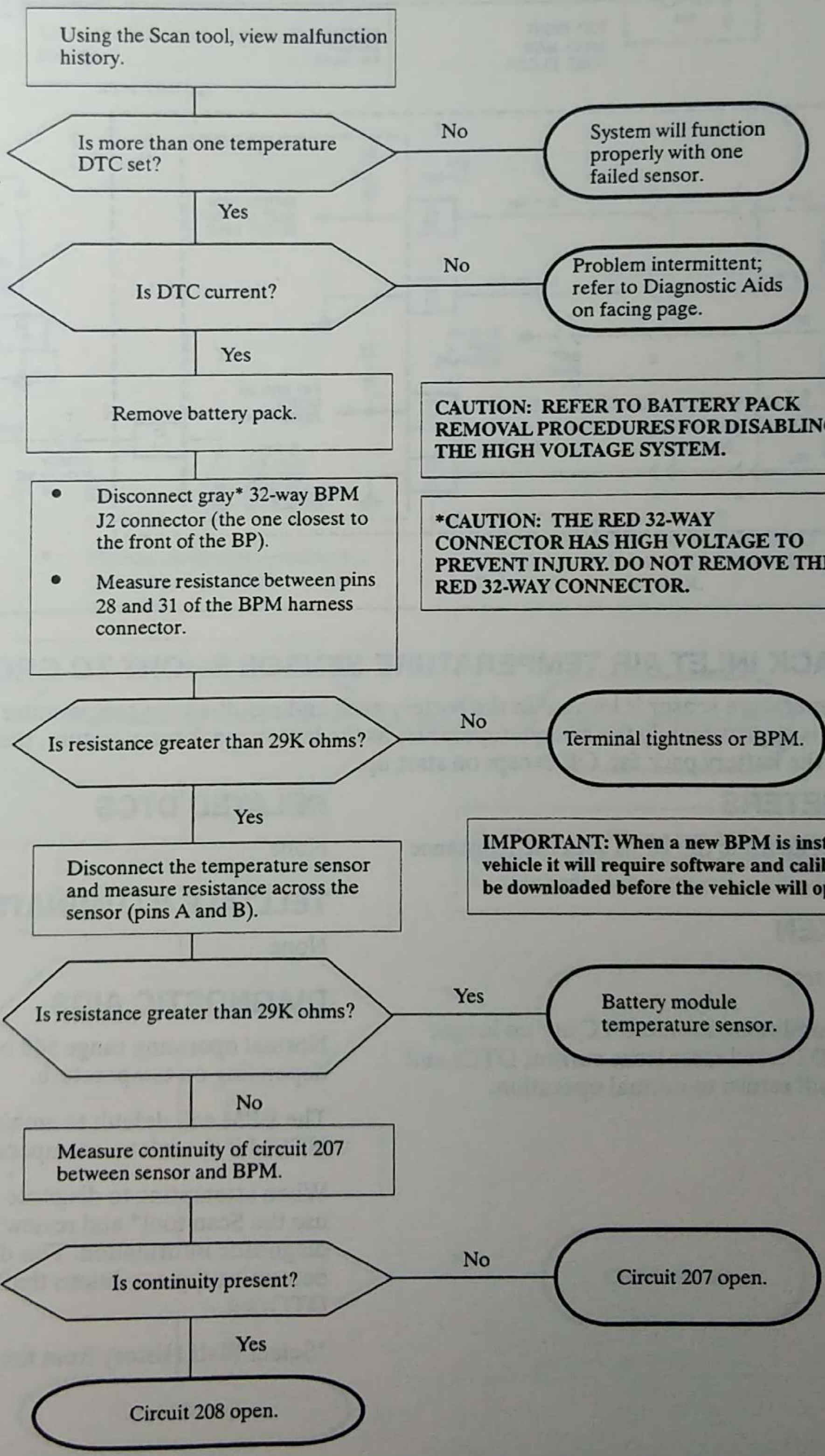
Normal operating range 548 ohms to 29K ohms depending on temperature.

The BPM will default to ambient temperature from the HTCM if the inlet air temperature sensor foils.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

DTC 265
BATTERY PACK INLET AIR TEMPERATURE SENSOR OPEN/SHORT TO B+

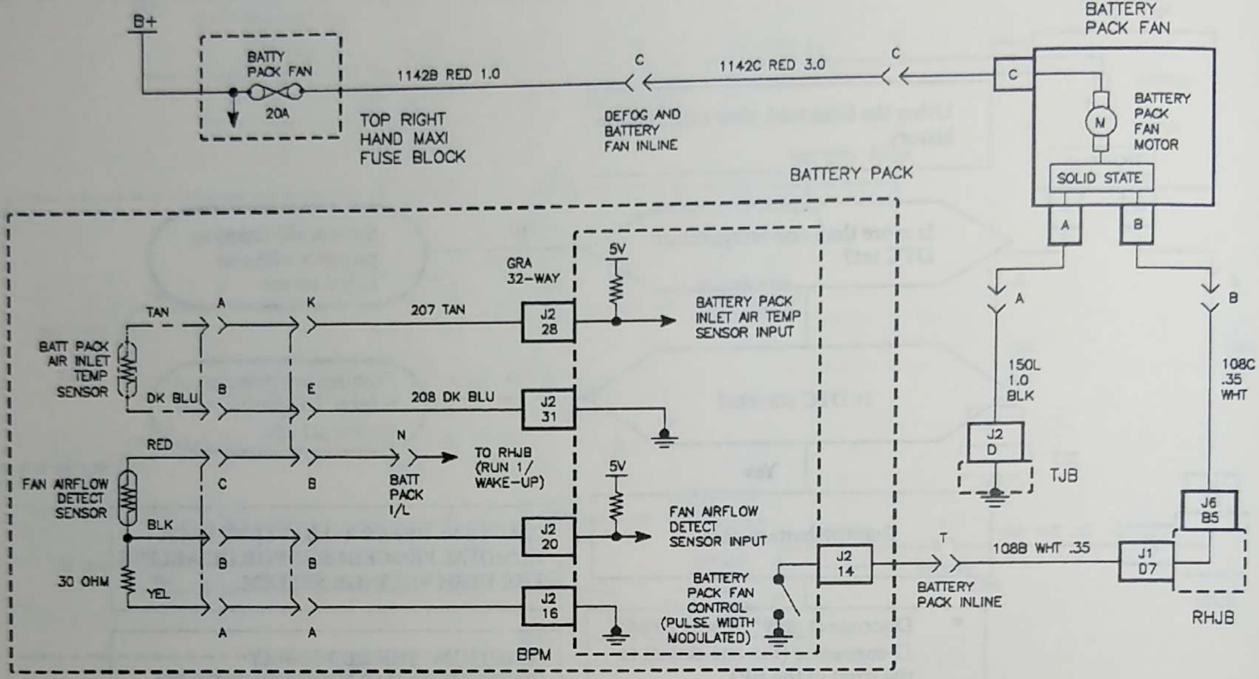

Using the Scan tool, view malfunction history.
Is more than one temperature DTC set?
No
System will function properly with one failed sensor.
Yes
Is DTC current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Remove battery pack.
• Disconnect gray* 32-way BPM J2 connector (the one closest to the front of the BP).
• Measure resistance between pins 28 and 31 of the BPM harness connector.
Is resistance greater than 29K ohms?
No
Terminal tightness or BPM.
Yes
Disconnect the temperature sensor and measure resistance across the sensor (pins A and B).
Is resistance greater than 29K ohms?
Yes
Battery module temperature sensor.
No
Measure continuity of circuit 207 between sensor and BPM.
Is continuity present?
No
Circuit 207 open.
Yes
Circuit 208 open.

CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.

***CAUTION: THE RED 32-WAY CONNECTOR HAS HIGH VOLTAGE TO PREVENT INJURY. DO NOT REMOVE THE RED 32-WAY CONNECTOR.**

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 266 – BATTERY PACK INLET AIR TEMPERATURE SENSOR SHORT TO GROUND


B+
BATTY PACK FAN
20A
1142B RED 1.0
TOP RIGHT HAND MAXI FUSE BLOCK
C
1142C RED 3.0
C
DEFOG AND BATTERY FAN INLINE
BATTERY PACK FAN
C
BATTERY PACK FAN MOTOR
M
SOLID STATE
A
B
BATTERY PACK
A
B
150L 1.0 BLK
108C .35 WHT
J2 D
TJB
J6 B5
GRA 32-WAY
5V
TAN
A
K
207 TAN
J2 28
BATTERY PACK INLET AIR TEMP SENSOR INPUT
BATT PACK AIR INLET TEMP SENSOR
DK BLU
B
E
208 DK BLU
J2 31
RED
N
TO RHJB (RUN 1/ WAKE–UP)
FAN AIRFLOW DETECT SENSOR
C
B
BATT PACK I/L
5V
BLK
J2 20
FAN AIRFLOW DETECT SENSOR INPUT
B
B
30 OHM
YEL
J2 16
A
A
BPM
J2 14
BATTERY PACK FAN CONTROL (PULSE WIDTH MODULATED)
T
108B WHT .35
BATTERY PACK INLINE
J1 D7
RHJB

PSMELC68198AA

BATTERY PACK INLET AIR TEMPERATURE SENSOR SHORT TO GROUND

The inlet air temperature sensor is located in the battery pack and monitors the temperature of the incoming air. If the incoming air is approximately the same temperature as the battery pack temperature, the battery pack module (BPM) will turn the battery pack fan Off except on start up.

DTC PARAMETERS

This DTC will set anytime the BPM sees the resistance below 548 ohms.

ACTION TAKEN

- The DTC is set.
- If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

Normal operating range 548 ohms to 29K ohms depending on temperature.

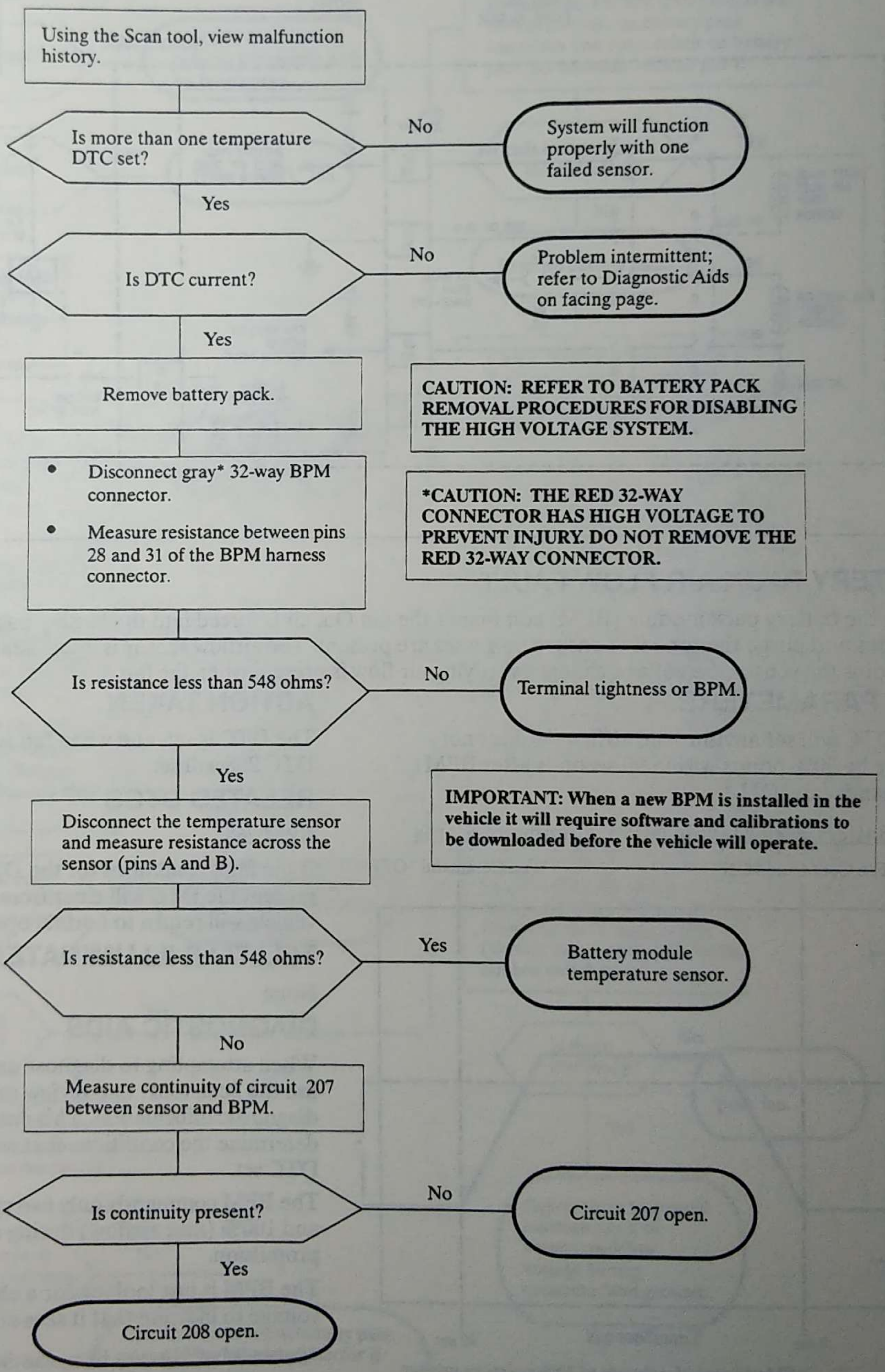
The BPM will default to ambient temperature from the HTCM if the inlet air temperature sensor foils.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTCs set.

*Select Malf History from the Scan tool BPM menu.

CS CamScanner

DTC 266
BATTERY PACK INLET AIR TEMPERATURE SENSOR SHORT TO GROUND

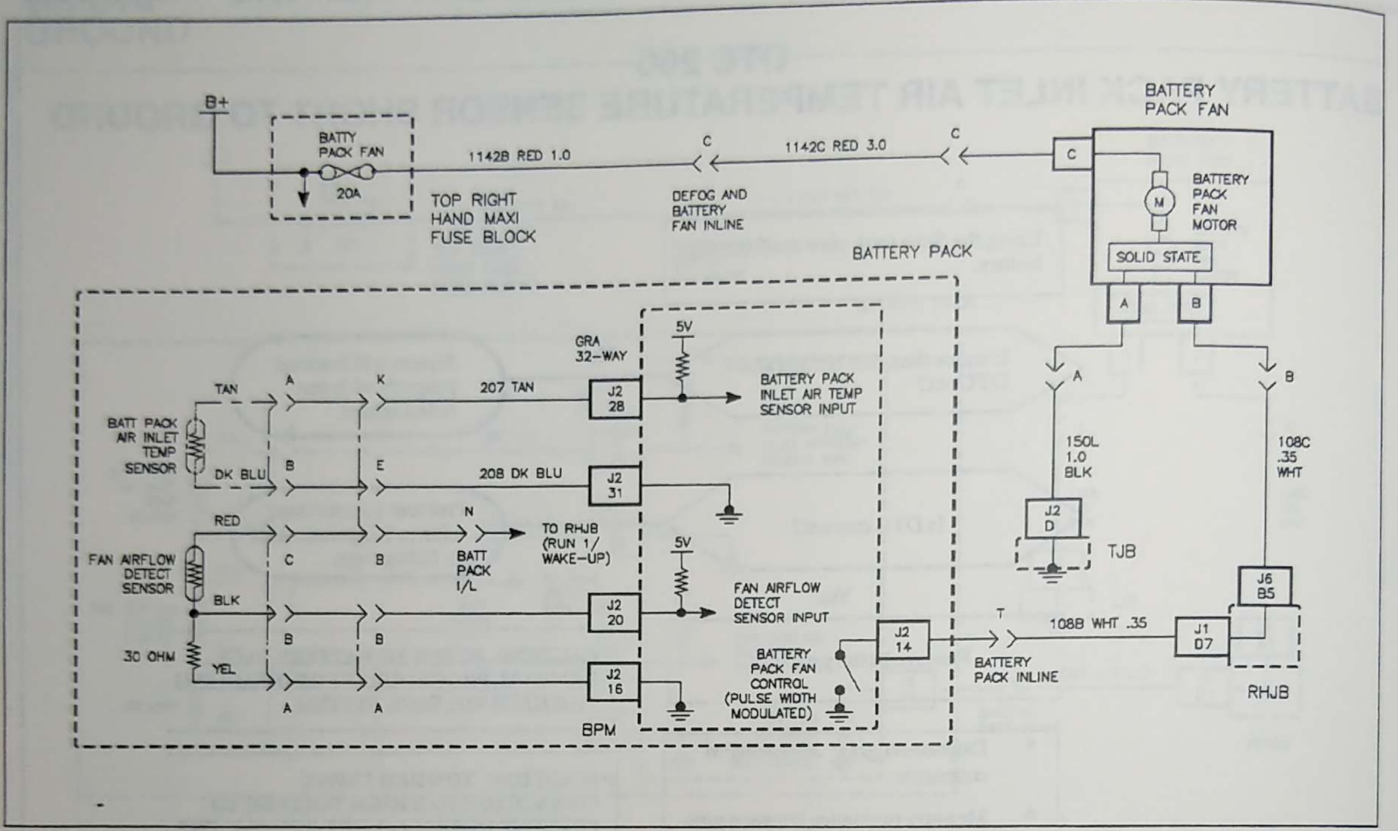

Using the Scan tool, view malfunction history.
Is more than one temperature DTC set?
No
System will function properly with one failed sensor.
Yes
Is DTC current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Remove battery pack.
• Disconnect gray* 32-way BPM connector.
• Measure resistance between pins 28 and 31 of the BPM harness connector.
Is resistance less than 548 ohms?
No
Terminal tightness or BPM.
Yes
Disconnect the temperature sensor and measure resistance across the sensor (pins A and B).
Is resistance less than 548 ohms?
Yes
Battery module temperature sensor.
No
Measure continuity of circuit 207 between sensor and BPM.
Is continuity present?
No
Circuit 207 open.
Yes
Circuit 208 open.

CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.

***CAUTION: THE RED 32-WAY CONNECTOR HAS HIGH VOLTAGE TO PREVENT INJURY. DO NOT REMOVE THE RED 32-WAY CONNECTOR.**

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 267 – BATTERY PACK AIR FLOW FAULT


B+
BATTY PACK FAN
20A
TOP RIGHT HAND MAXI FUSE BLOCK
1142B RED 1.0
C
DEFOG AND BATTERY FAN INLINE
1142C RED 3.0
C
BATTERY PACK FAN
C
M
BATTERY PACK FAN MOTOR
SOLID STATE
A
B
BATTERY PACK
A
B
150L 1.0 BLK
108C .35 WHT
J2 D
TJB
J6 B5
J1 D7
RHJB
108B WHT .35
T
BATTERY PACK INLINE
GRA 32-WAY
5V
BATT PACK AIR INLET TEMP SENSOR
TAN
DK BLU
A
K
B
E
207 TAN
208 DK BLU
J2 28
J2 31
BATTERY PACK INLET AIR TEMP SENSOR INPUT
RED
N
TO RHJB (RUN 1/ WAKE-UP)
BATT PACK I/L
FAN AIRFLOW DETECT SENSOR
BLK
C
B
B
B
J2 20
5V
FAN AIRFLOW DETECT SENSOR INPUT
30 OHM
YEL
A
A
J2 16
J2 14
BATTERY PACK FAN CONTROL (PULSE WIDTH MODULATED)
BPM

PSMELC68198AA

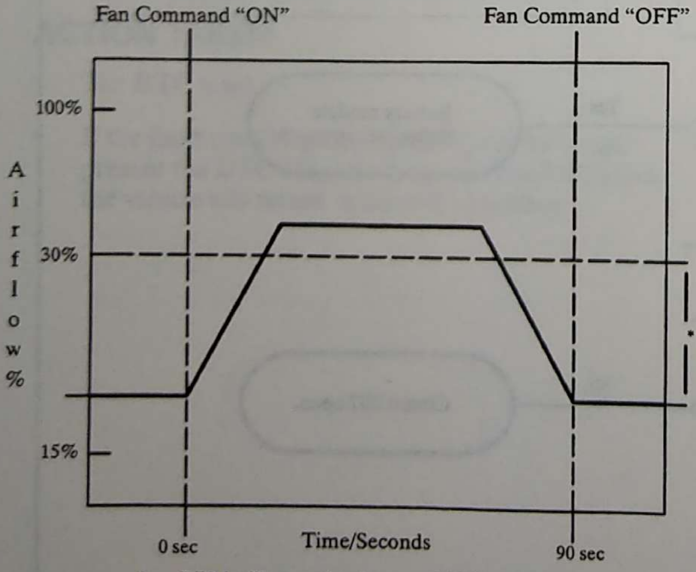
BATTERY PACK AIR FLOW FAULT

When the battery pack module (BPM) commands the fan On, air is forced into the battery pack tunnel to cool the batteries and purge the tunnel to ensure no gasses are present. The airflow sensor is a self-heating sensor and as air flow cools the sensor the voltage changes verifying air flow is present when the fan

DTC PARAMETERS

This DTC will set anytime the airflow % does not change by 30% points within 90 seconds after BPM commands fan "ON."

Battery Pack Module (BPM) Command Status



* BPM will record a change of 30% points or greater (During normal operation)

ACTION TAKEN

The DTC is set, and when fan is commanded On, DTC 268 will set.

RELATED DTCS

BPM 268

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

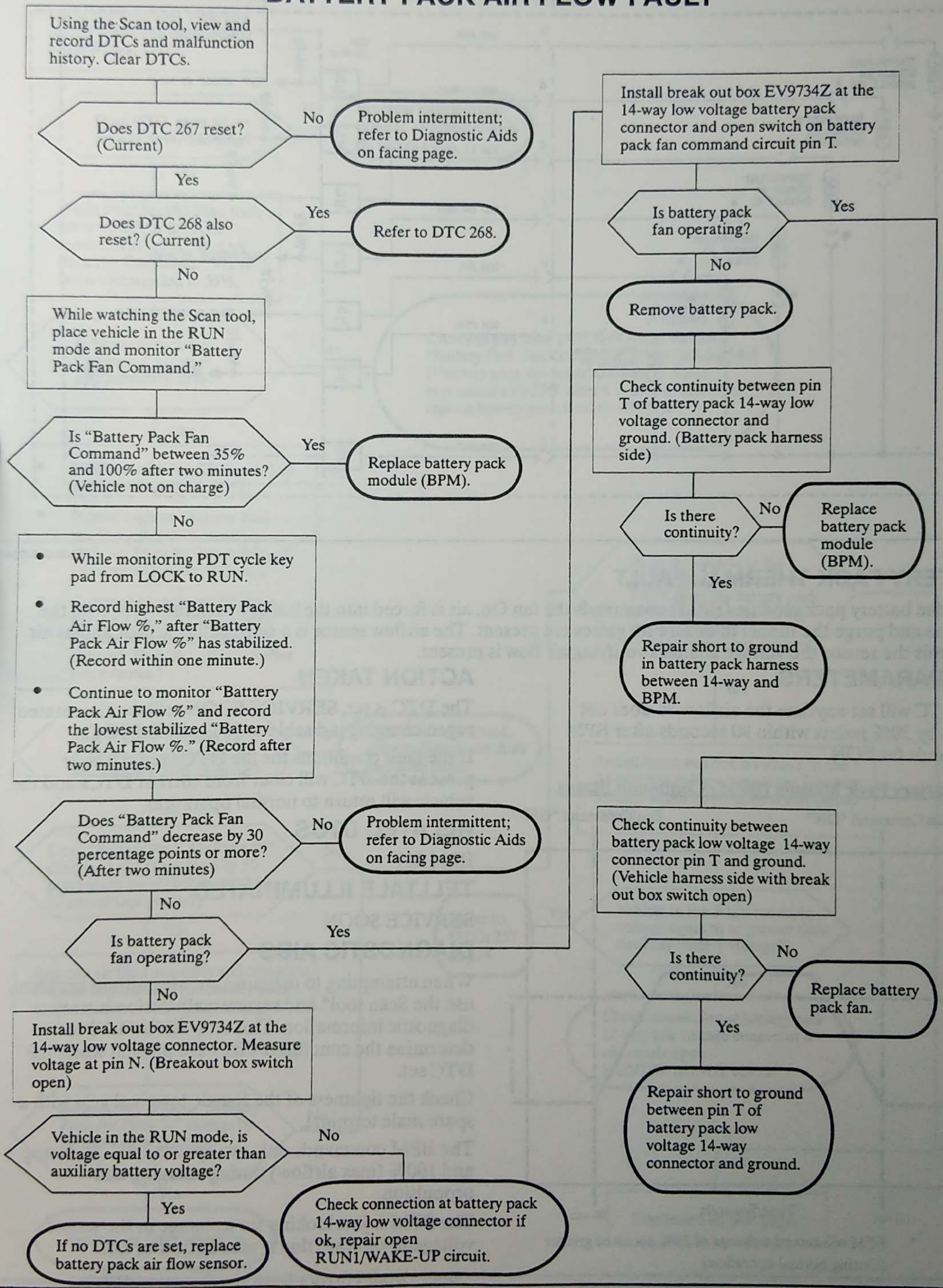
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

The BPM commands only two speeds, 35% at startup and 100% (max airflow) during charging and propulsion.

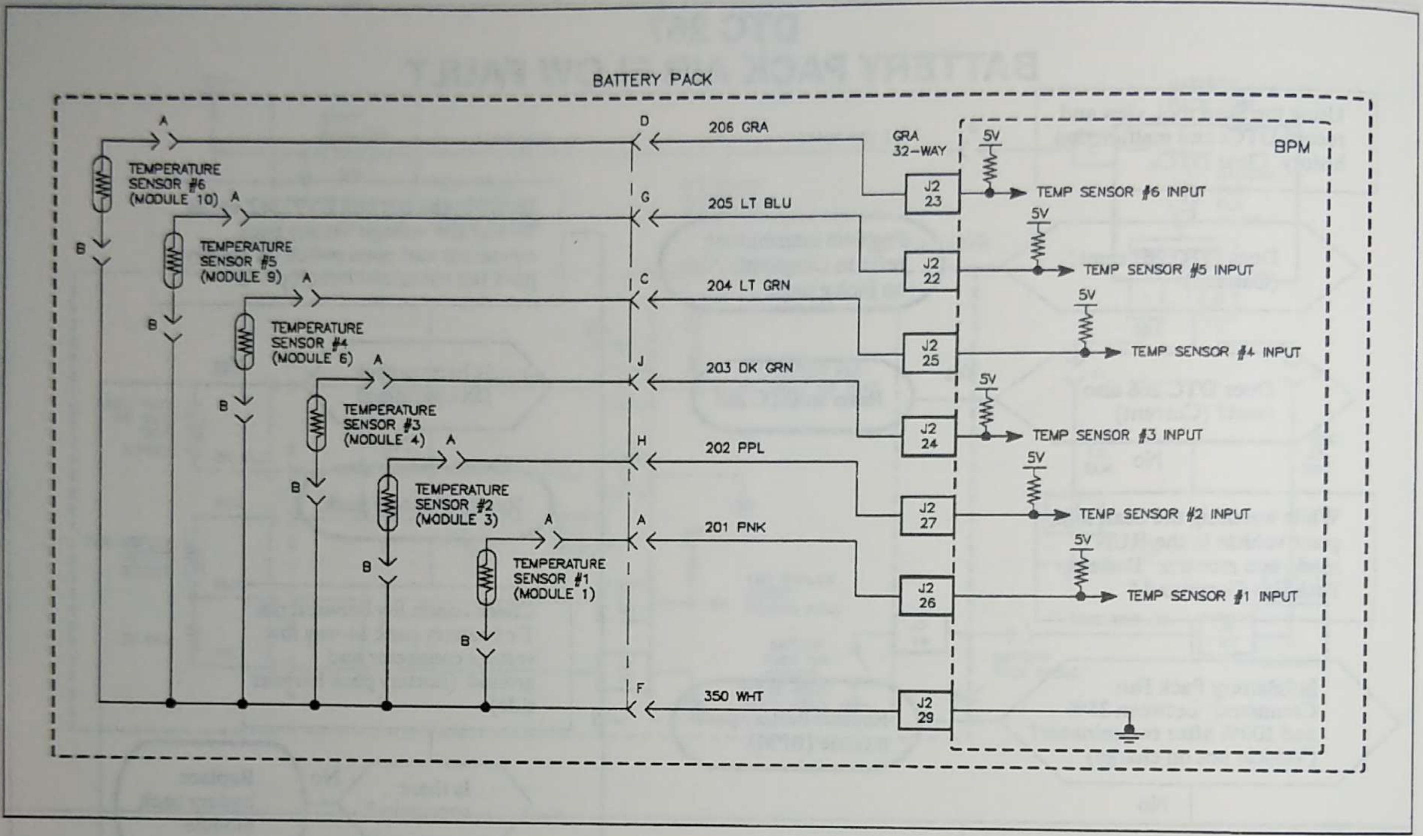
The BPM is just looking for a change in the sensor voltage to indicate that it sees airflow.

*Select Malf History from the Scan tool BPM menu.

DTC 267
BATTERY PACK AIR FLOW FAULT


Using the Scan tool, view and record DTCs and malfunction history. Clear DTCs.
Does DTC 267 reset? (Current)
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Does DTC 268 also reset? (Current)
Yes
Refer to DTC 268.
No
While watching the Scan tool, place vehicle in the RUN mode and monitor "Battery Pack Fan Command."
Is "Battery Pack Fan Command" between 35% and 100% after two minutes? (Vehicle not on charge)
Yes
Replace battery pack module (BPM).
No
• While monitoring PDT cycle key pad from LOCK to RUN.
• Record highest "Battery Pack Air Flow %," after "Battery Pack Air Flow %" has stabilized. (Record within one minute.)
• Continue to monitor "Battery Pack Air Flow %" and record the lowest stabilized "Battery Pack Air Flow %." (Record after two minutes.)
Does "Battery Pack Fan Command" decrease by 30 percentage points or more? (After two minutes)
No
Problem intermittent; refer to Diagnostic Aids on facing page.
No
Is battery pack fan operating?
Yes
No
Install break out box EV9734Z at the 14-way low voltage connector. Measure voltage at pin N. (Breakout box switch open)
Vehicle in the RUN mode, is voltage equal to or greater than auxiliary battery voltage?
No
Check connection at battery pack 14-way low voltage connector if ok, repair open RUN1/WAKE-UP circuit.
Yes
If no DTCs are set, replace battery pack air flow sensor.
Install break out box EV9734Z at the 14-way low voltage battery pack connector and open switch on battery pack fan command circuit pin T.
Is battery pack fan operating?
Yes
No
Remove battery pack.
Check continuity between pin T of battery pack 14-way low voltage connector and ground. (Battery pack harness side)
Is there continuity?
No
Replace battery pack module (BPM).
Yes
Repair short to ground in battery pack harness between 14-way and BPM.
Check continuity between battery pack low voltage 14-way connector pin T and ground. (Vehicle harness side with break out box switch open)
Is there continuity?
No
Replace battery pack fan.
Yes
Repair short to ground between pin T of battery pack low voltage 14-way connector and ground.

DTC 268 – BATTERY PACK THERMAL FAULT


BATTERY PACK
TEMPERATURE SENSOR #6 (MODULE 10)
TEMPERATURE SENSOR #5 (MODULE 9)
TEMPERATURE SENSOR #4 (MODULE 6)
TEMPERATURE SENSOR #3 (MODULE 4)
TEMPERATURE SENSOR #2 (MODULE 3)
TEMPERATURE SENSOR #1 (MODULE 1)
A
B
D
G
C
J
H
A
F
206 GRA
205 LT BLU
204 LT GRN
203 DK GRN
202 PPL
201 PNK
350 WHT
GRA 32-WAY
J2 23
J2 22
J2 25
J2 24
J2 27
J2 26
J2 29
5V
BPM
TEMP SENSOR #6 INPUT
TEMP SENSOR #5 INPUT
TEMP SENSOR #4 INPUT
TEMP SENSOR #3 INPUT
TEMP SENSOR #2 INPUT
TEMP SENSOR #1 INPUT

PSMELC68200AA

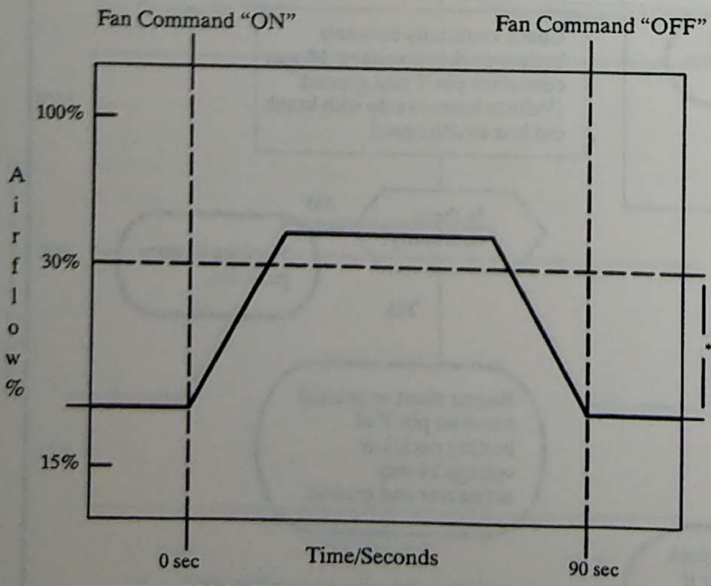
BATTERY PACK THERMAL FAULT

When the battery pack module (BPM) commands the fan On, air is forced into the battery pack tunnel to cool the batteries and purge the tunnel to ensure no gasses are present. The airflow sensor is a self-heating sensor and as air flow cools the sensor the voltage changes verifying air flow is present.

DTC PARAMETERS

This DTC will set anytime the airflow % does not change by 30% points within 90 seconds after BPM commands fan "ON."

Battery Pack Module (BPM) Command Status



* BPM will record a change of 30% points or greater (During normal operation)

ACTION TAKEN

The DTC is set, SERVICE SOON telltale illuminated regen/charging is disable at 70%–80% PSOC.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 267

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

Check the tightness of the female terminal grip with a spare male terminal.

The BPM commands only two speeds, 35% at startup and 100% (max airflow) during charging and propulsion.

The BPM is just looking for a change in the sensor voltage to indicate that it sees airflow or not.

*Select Malf History from the Scan tool HTCM menu.

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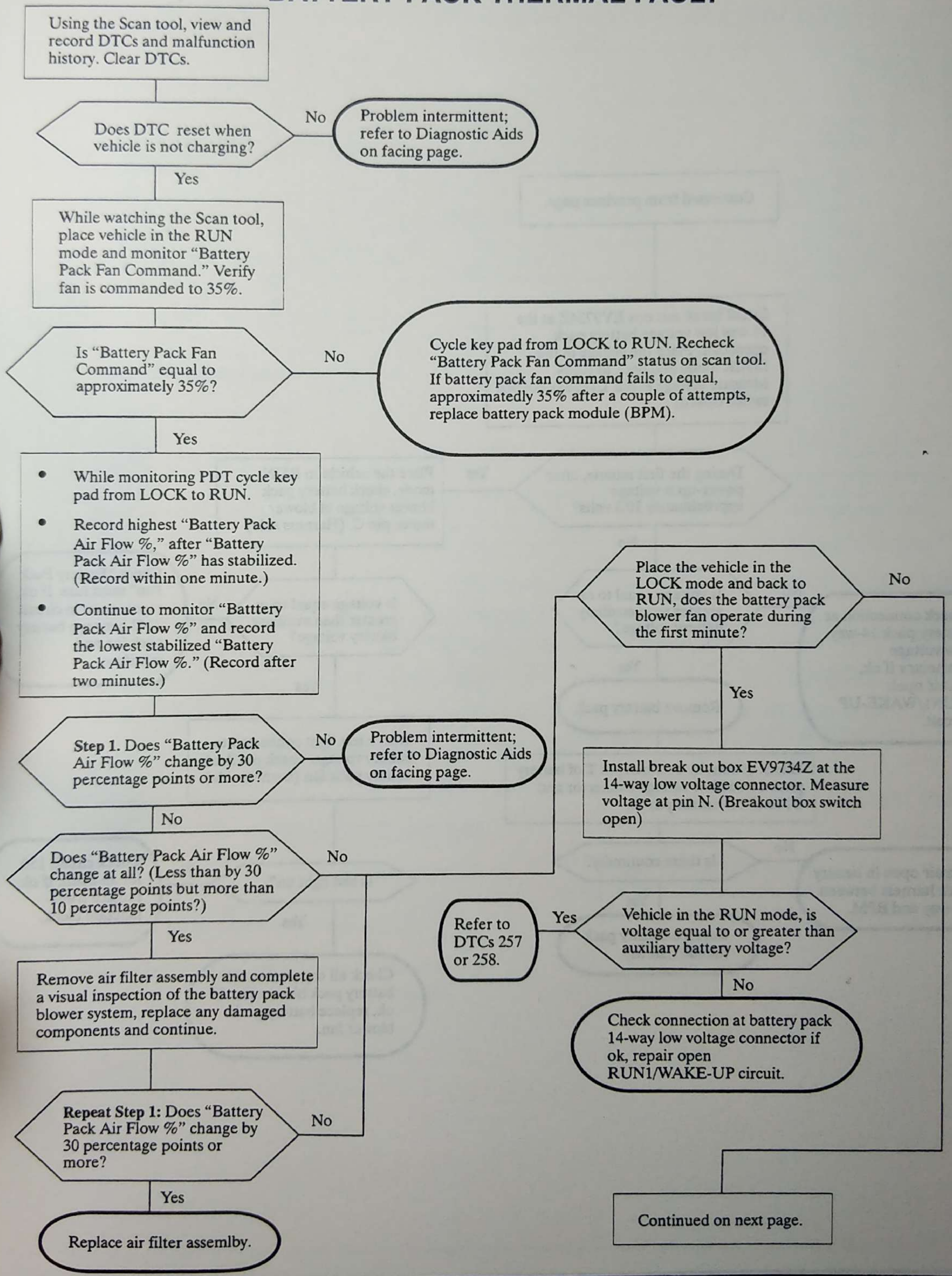
DTC 268
BATTERY PACK THERMAL FAULT



Using the Scan tool, view and record DTCs and malfunction history. Clear DTCs.

Does DTC reset when vehicle is not charging?

Problem intermittent; refer to Diagnostic Aids on facing page.

While watching the Scan tool, place vehicle in the RUN mode and monitor "Battery Pack Fan Command." Verify fan is commanded to 35%.

Is "Battery Pack Fan Command" equal to approximately 35%?

Cycle key pad from LOCK to RUN. Recheck "Battery Pack Fan Command" status on scan tool. If battery pack fan command fails to equal, approximatedly 35% after a couple of attempts, replace battery pack module (BPM).

- While monitoring PDT cycle key pad from LOCK to RUN.
- Record highest "Battery Pack Air Flow %," after "Battery Pack Air Flow %" has stabilized. (Record within one minute.)
- Continue to monitor "Batttery Pack Air Flow %" and record the lowest stabilized "Battery Pack Air Flow %." (Record after two minutes.)

Step 1. Does "Battery Pack Air Flow %" change by 30 percentage points or more?

Problem intermittent; refer to Diagnostic Aids on facing page.

Does "Battery Pack Air Flow %" change at all? (Less than by 30 percentage points but more than 10 percentage points?)

Remove air filter assembly and complete a visual inspection of the battery pack blower system, replace any damaged components and continue.

Repeat Step 1: Does "Battery Pack Air Flow %" change by 30 percentage points or more?

Replace air filter assemlby.

Place the vehicle in the LOCK mode and back to RUN, does the battery pack blower fan operate during the first minute?

Install break out box EV9734Z at the 14-way low voltage connector. Measure voltage at pin N. (Breakout box switch open)

Vehicle in the RUN mode, is voltage equal to or greater than auxiliary battery voltage?

Refer to DTCs 257 or 258.

Check connection at battery pack 14-way low voltage connector if ok, repair open RUN1/WAKE-UP circuit.

Continued on next page.

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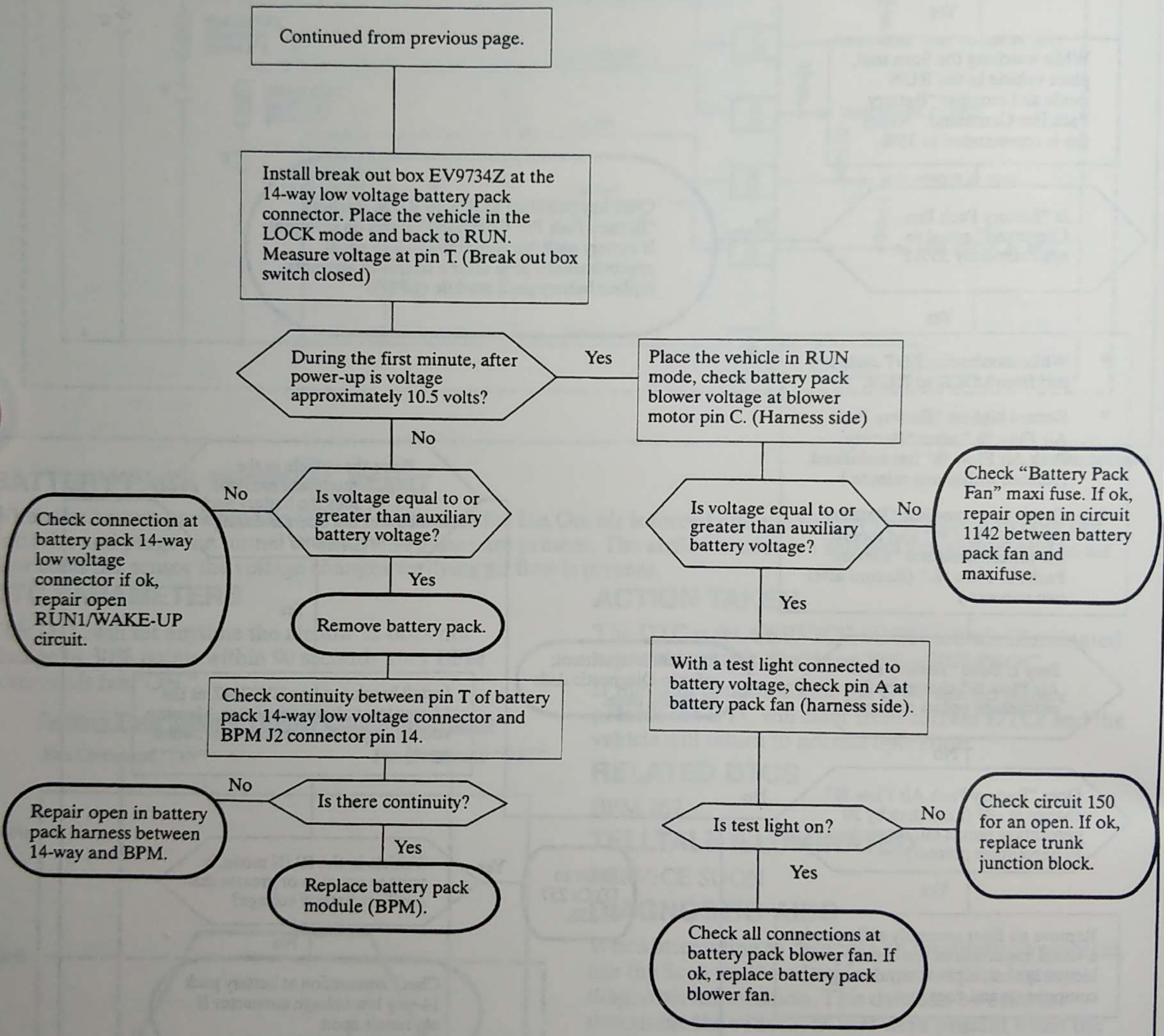
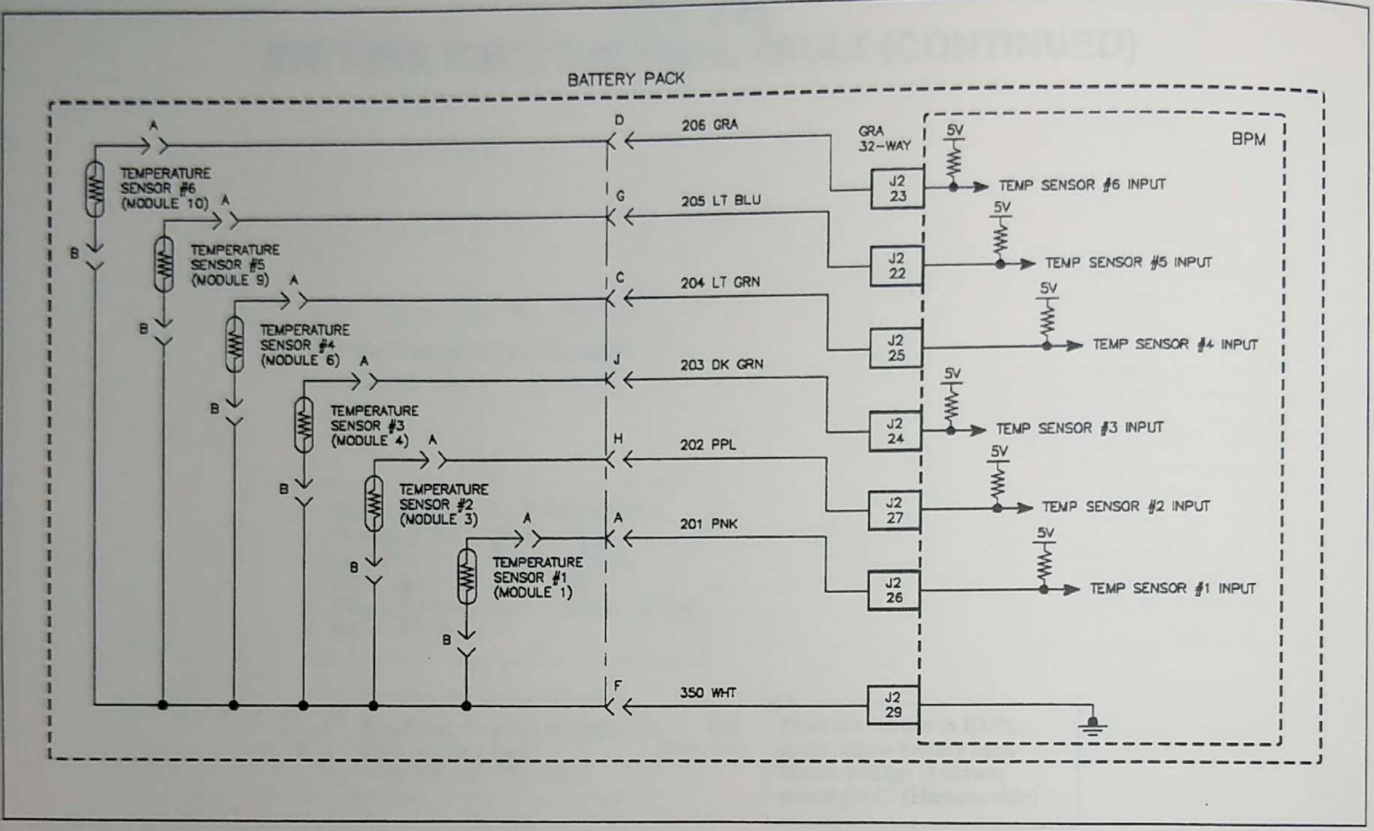
DTC 268
BATTERY PACK THERMAL FAULT (CONTINUED)


Continued from previous page.
Install break out box EV9734Z at the 14-way low voltage battery pack connector. Place the vehicle in the LOCK mode and back to RUN. Measure voltage at pin T. (Break out box switch closed)
During the first minute, after power-up is voltage approximately 10.5 volts?
Yes
Place the vehicle in RUN mode, check battery pack blower voltage at blower motor pin C. (Harness side)
No
Is voltage equal to or greater than auxiliary battery voltage?
No
Check connection at battery pack 14-way low voltage connector if ok, repair open RUN1/WAKE-UP circuit.
Yes
Remove battery pack.
Check continuity between pin T of battery pack 14-way low voltage connector and BPM J2 connector pin 14.
Is there continuity?
No
Repair open in battery pack harness between 14-way and BPM.
Yes
Replace battery pack module (BPM).
Is voltage equal to or greater than auxiliary battery voltage?
No
Check "Battery Pack Fan" maxi fuse. If ok, repair open in circuit 1142 between battery pack fan and maxifuse.
Yes
With a test light connected to battery voltage, check pin A at battery pack fan (harness side).
Is test light on?
No
Check circuit 150 for an open. If ok, replace trunk junction block.
Yes
Check all connections at battery pack blower fan. If ok, replace battery pack blower fan.

NOTES

DTC 269 – BATTERY PACK PROPULSION OVERTEMP FAULT


BATTERY PACK
TEMPERATURE SENSOR #6 (MODULE 10)
TEMPERATURE SENSOR #5 (MODULE 9)
TEMPERATURE SENSOR #4 (MODULE 6)
TEMPERATURE SENSOR #3 (MODULE 4)
TEMPERATURE SENSOR #2 (MODULE 3)
TEMPERATURE SENSOR #1 (MODULE 1)
A
B
D
G
C
J
H
F
206 GRA
205 LT BLU
204 LT GRN
203 DK GRN
202 PPL
201 PNK
350 WHT
GRA 32-WAY
J2 23
J2 22
J2 25
J2 24
J2 27
J2 26
J2 29
5V
BPM
TEMP SENSOR #6 INPUT
TEMP SENSOR #5 INPUT
TEMP SENSOR #4 INPUT
TEMP SENSOR #3 INPUT
TEMP SENSOR #2 INPUT
TEMP SENSOR #1 INPUT
PSMELC68200AA

BATTERY PACK PROPULSION OVERTEMP FAULT

There are six temperature sensors the battery pack module (BPM) uses to determine the temperature of the batteries. If the batteries get too hot, the battery life can be reduced.

DTC PARAMETERS

This DTC will set anytime the BPM sees the temperature exceed 60°C (140°F) and the vehicle is not charging.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

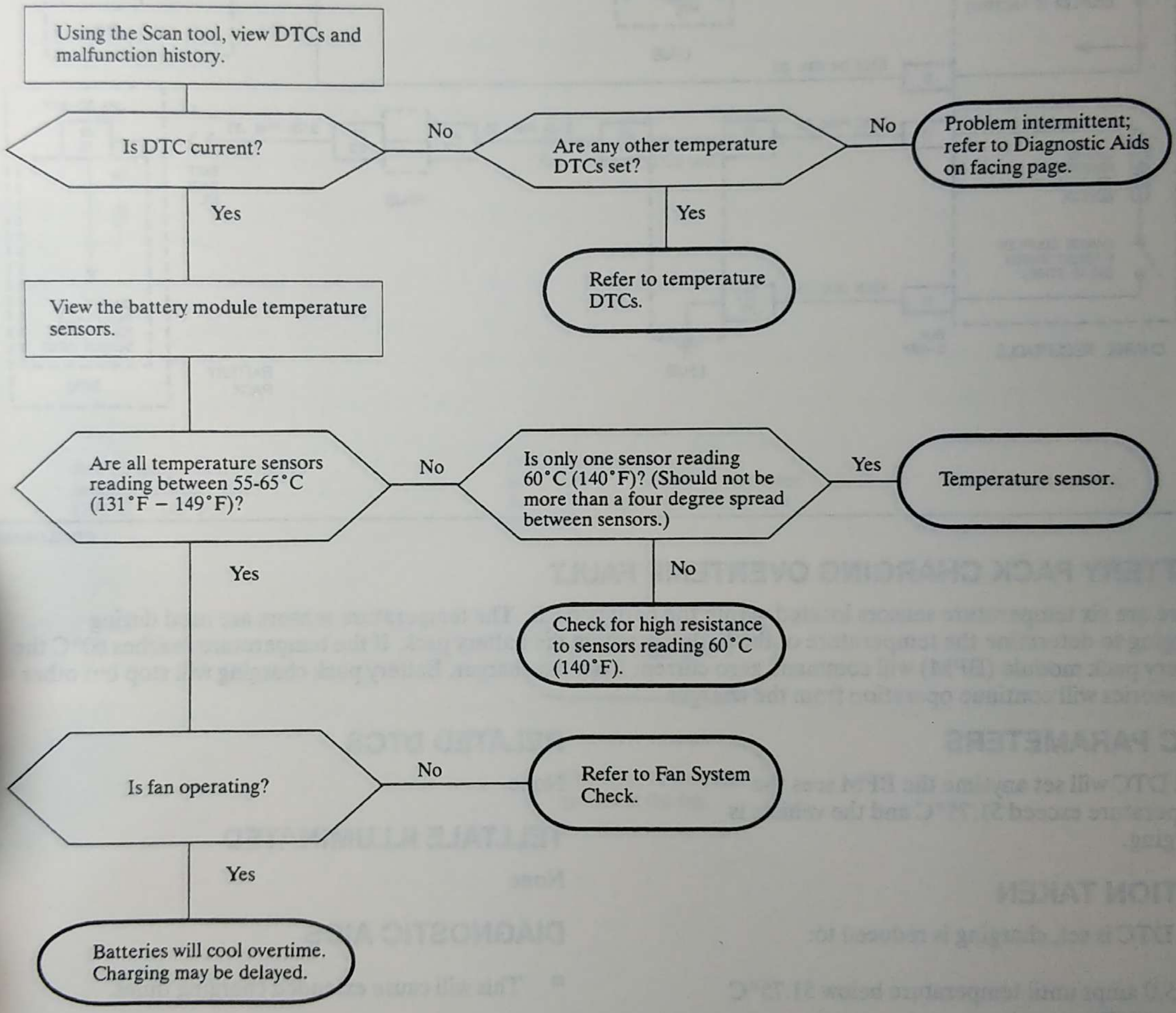
TELLTALE ILLUMINATED

None

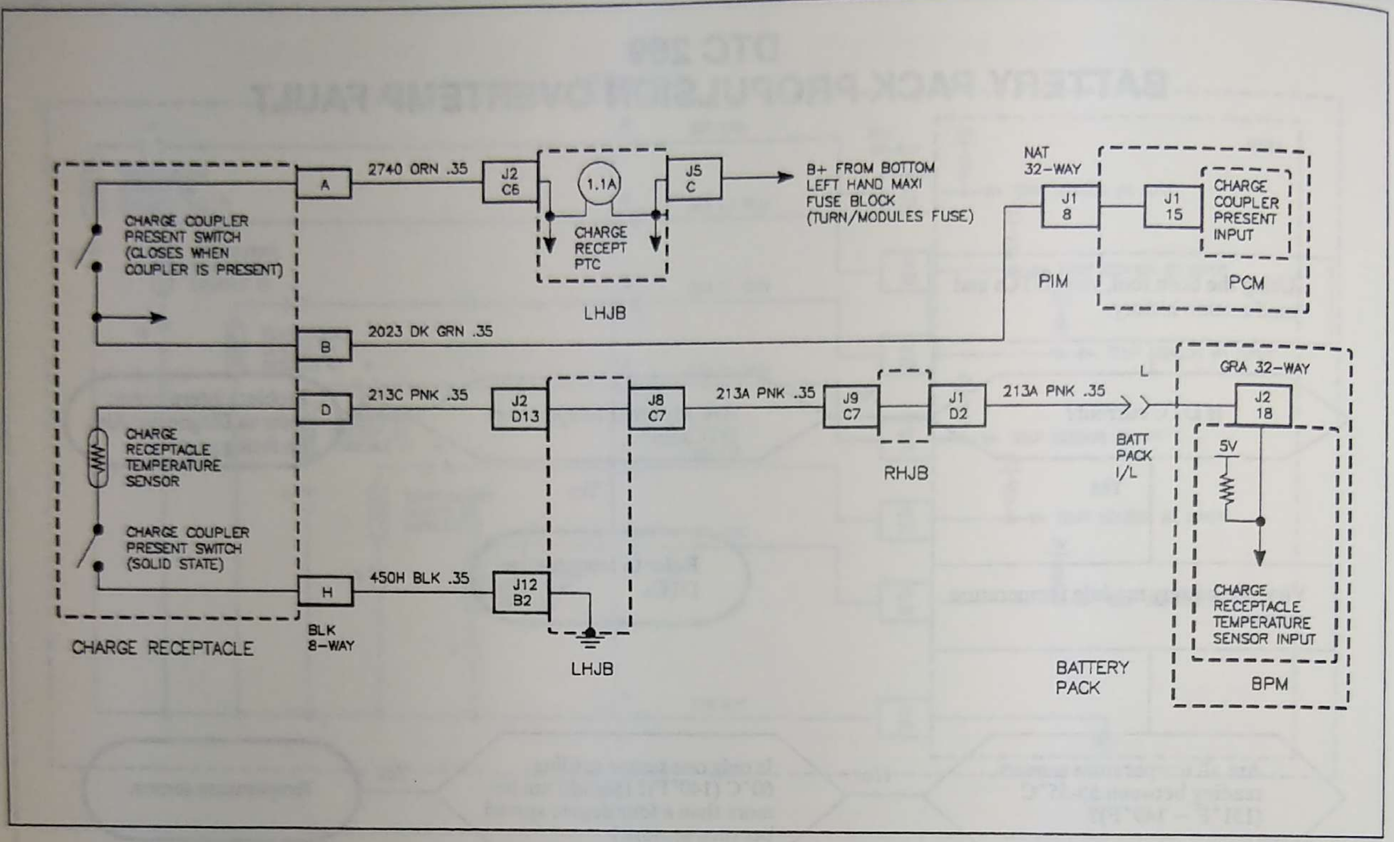
DIAGNOSTIC AIDS

- Hot, ambient conditions (above 31.9°C [90°F]) and/or a constant drive-charge cycle can set this DTC. This does not indicate a failure.
- Sensors should read within four degrees of each other.

DTC 269
BATTERY PACK PROPULSION OVERTEMP FAULT


Using the Scan tool, view DTCs and malfunction history.
Is DTC current?
No
Are any other temperature DTCs set?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Refer to temperature DTCs.
Yes
View the battery module temperature sensors.
Are all temperature sensors reading between 55-65°C (131°F – 149°F)?
No
Is only one sensor reading 60°C (140°F)? (Should not be more than a four degree spread between sensors.)
Yes
Temperature sensor.
No
Check for high resistance to sensors reading 60°C (140°F).
Yes
Is fan operating?
No
Refer to Fan System Check.
Yes
Batteries will cool overtime. Charging may be delayed.

DTC 270 – BATTERY PACK CHARGING OVERTEMP FAULT


CHARGE COUPLER PRESENT SWITCH (CLOSES WHEN COUPLER IS PRESENT)
A
2740 ORN .35
J2 C6
1.1A
CHARGE RECEPT PTC
J5 C
B+ FROM BOTTOM LEFT HAND MAXI FUSE BLOCK (TURN/MODULES FUSE)
NAT 32–WAY
J1 8
J1 15
CHARGE COUPLER PRESENT INPUT
PIM
PCM
LHJB
B
2023 DK GRN .35
D
213C PNK .35
J2 D13
J8 C7
213A PNK .35
J9 C7
J1 D2
213A PNK .35
L
GRA 32–WAY
J2 18
BATT PACK I/L
RHJB
5V
CHARGE RECEPTACLE TEMPERATURE SENSOR
CHARGE COUPLER PRESENT SWITCH (SOLID STATE)
H
450H BLK .35
J12 B2
CHARGE RECEPTACLE TEMPERATURE SENSOR INPUT
CHARGE RECEPTACLE
BLK 8–WAY
LHJB
BATTERY PACK
BPM

PSMELC68199AA

BATTERY PACK CHARGING OVERTEMP FAULT

There are six temperature sensors located within the battery pack. The temperature sensors are used during charging to determine the temperature of the batteries within the battery pack. If the temperature reaches 60°C the battery pack module (BPM) will command zero current from the charger. Battery pack charging will stop but other accessories will continue operation from the charger.

DTC PARAMETERS

This DTC will set anytime the BPM sees the temperature exceed 51.75°C and the vehicle is charging.

ACTION TAKEN

The DTC is set, charging is reduced to:

- 5.0 amps until temperature below 51.75°C (125°F).
- 10 amps until temperature has decreased below 52°C (42.75°F).
- Zero amps until temperature has decreased below 60°C (140°F).

After charging has shut off or stepped down, the temperature must drop 2.25°C (36.1°F) below threshold before charging will begin.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

- This will cause extended charging times.
- Refer to the charge event history table for information on the last four charging events.
- Hot, ambient conditions (above 31.9°C [90°F]) and/or a constant drive-charge cycle can set this DTC. This does not indicate a failure.

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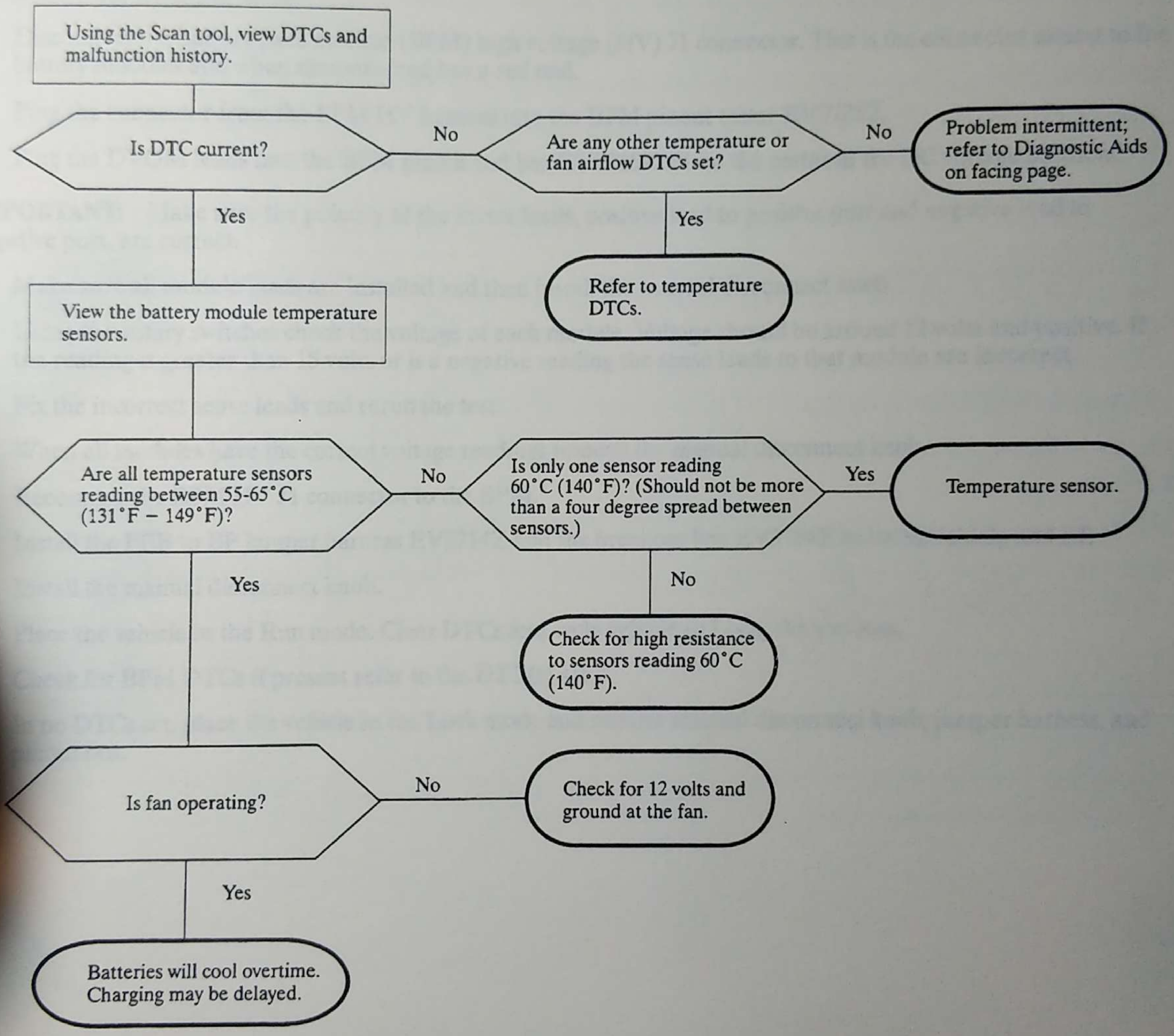
DTC 270
BATTERY PACK CHARGING OVERTEMP FAULT


Using the Scan tool, view DTCs and malfunction history.
Is DTC current?
No
Are any other temperature or fan airflow DTCs set?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Refer to temperature DTCs.
Yes
View the battery module temperature sensors.
Are all temperature sensors reading between 55-65°C (131°F – 149°F)?
No
Is only one sensor reading 60°C (140°F)? (Should not be more than a four degree spread between sensors.)
Yes
Temperature sensor.
No
Check for high resistance to sensors reading 60°C (140°F).
Yes
Is fan operating?
No
Check for 12 volts and ground at the fan.
Yes
Batteries will cool overtime. Charging may be delayed.

NOTES

BATTERY PACK SYSTEM TEST

NOTICE: If this test is not run and the sense leads are connected incorrectly battery pack module (BPM) damage will occur when the vehicle is placed in the run mode or BPM receives the wake-up signal.

1. When new modules have been installed, assemble the battery pack (BP) except for the top covers.

CAUTION: THE BPM J1 CONNECTOR HAS HIGH VOLTAGE (HV) CAREFULLY DISCONNECT CONNECTION PULLING STRAIT REARWARD. DO NOT TOUCH PINS OR PLACE ANYTHING ACROSS THE PINS OF THE CONNECTOR.

2. Disconnect the battery pack module (BPM) high voltage (HV) J1 connector. This is the connector closest to the battery modules and when disconnected has a red end.
3. Plug the connector from the BPM HV harness into the BPM pinout tester EV9725Z.
4. Plug the DVOM leads into the BPM pinout test box EV9725Z. Place the meter in the DC voltage position.

IMPORTANT: Make sure the polarity of the meter leads, positive lead to positive port and negative lead to negative port, are correct.

5. Make sure all module leads are installed and then install the manual disconnect knob.
6. Using the rotary switches check the voltage of each module. Voltage should be around 12 volts and positive. If the reading is greater than 15 volts or is a negative reading the sense leads to that module are incorrect.
7. Fix the incorrect sense leads and rerun the test.
8. When all modules have the correct voltage readings remove the manual disconnect knob.
9. Reconnect the BPM HV J1 connector to the BPM.
10. Install the PEB to BP jumper harness EV9714Z and the breakout box EV9734Z between vehicle and BP.
11. Install the manual disconnect knob.
12. Place the vehicle in the Run mode. Clear DTCs and cycle vehicle to Lock, then to Run.
13. Check for BPM DTCs if present refer to the DTC(s) set.
14. In no DTCs set, place the vehicle in the Lock mode and remove manual disconnect knob, jumper harness, and pinout box.

BATTERY VENT SYSTEM CHECK OUT

After servicing the battery pack, the vent system integrity must be checked for restrictions and leaks. If the vent system is not working properly, gases may build up in the battery tunnel.

1. Visually inspect all areas where service has been performed. Make sure no vent lines are pinched or misrouted.
2. Disconnect the filter from the front of pack vent tube, attached to the high voltage (HV) harness just below cannon connector, and attach a standard hand operated pressure pump.
3. Disconnect the outside vent cap on the module nearest the area that needed service (refer to chart on next page). Attach a second pressure gauge to the exposed vent port.

IMPORTANT: Refer to chart for proper gauge location according to the module serviced.

4. Pump three to four pounds per square inch (psi) of pressure on the vent harness. Pressure should hold steady for five minutes without dropping, this verifies there are no leaks in the system.
5. Verify pressure readings between the two gauges are the same within two psi. If the readings differ, there is restriction someplace in the vent harness. Most likely the restriction is in the area that was last serviced.
6. Relieve pressure, pull pump a pressure a second time and watch the rate of climb between the two gauges. Pressure gauges should mirror each other closely (within 14 kPa [2 psi]) on a properly functioning vent system. If gauge at the battery module is slow to react, there is a restriction in the vent system. Locate restriction and repair. Rerun test.
7. Remove pressure gauge from the outside of module and install a new cap on module.

NOTICE: Cap may have been damaged when it was removed. Install a new cap to insure proper vent system integrity.

8. Pump pressure for a third time to insure there are no leaks at the cap.
9. If system checks out, remove pressure pump and reinstall filter to vent harness. Be sure the filter is properly secured to the high voltage cable.

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MODULE SERVICED	VENT POSITION TO CHECK
Module 1	Vent cap 1
Module 2	Vent cap 2
Module 3	Vent cap 3
Module 4	Vent cap 4
Module 5	Vent cap 6
Module 6	Vent cap 6
Module 7	Vent cap 7
Module 8	Vent cap 8
Module 9	Vent cap 8
Module 10	Vent cap 7
Module 11	Vent cap 7
Module 12	Vent cap 12
Module 13	Vent cap 13
Module 14	Vent cap 14
Module 15	Vent cap 15
Module 16	Vent cap check with front top cover removed at 16
Module 17	Vent cap check with front top cover removed at 17
Module 18	Vent cap check with front top cover removed at 18
Module 19	Vent cap check with front top cover removed at 19
Module 20	Vent cap check with front top cover removed at 20
Module 21	Vent cap check with front top cover removed at 21
Module 22	Vent cap check with front top cover removed at 22
Module 23	Vent cap check with front top cover removed at 23
Module 24	Vent cap check with front top cover removed at 24
Module 25	Vent cap check with front top cover removed at 25
Module 26	Vent cap check with front top cover removed at 26

CS CamScanner

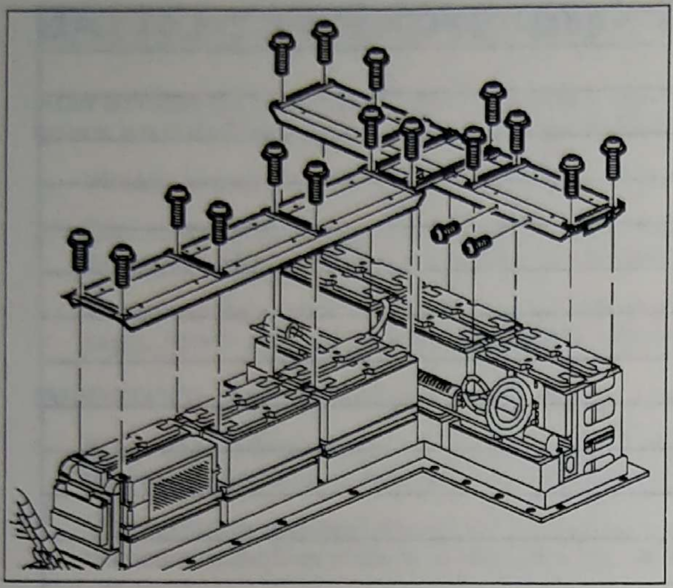
TEMPERATURE SENSOR

REMOVAL

1. Remove the battery pack from the vehicle. (Refer to "Battery Pack" removal in this manual.)

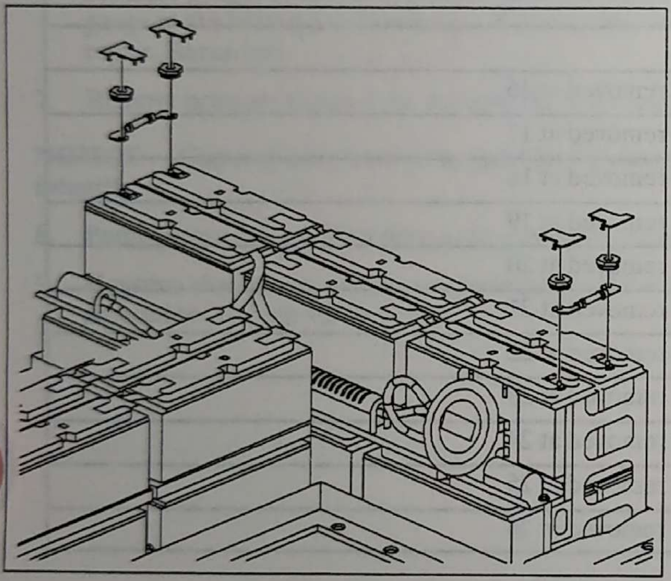
CAUTION: WITH THE BATTERY PACK OUT OF THE VEHICLE YOU ARE EXPOSED TO HIGH VOLTAGE. NEVER LEAN ON THE BATTERY PACK OR TOUCH THE BATTERY BACK WITH BOTH HANDS. FOLLOW ALL PROCEDURES STEP BY STEP.

2. Remove the top covers on the battery pack.



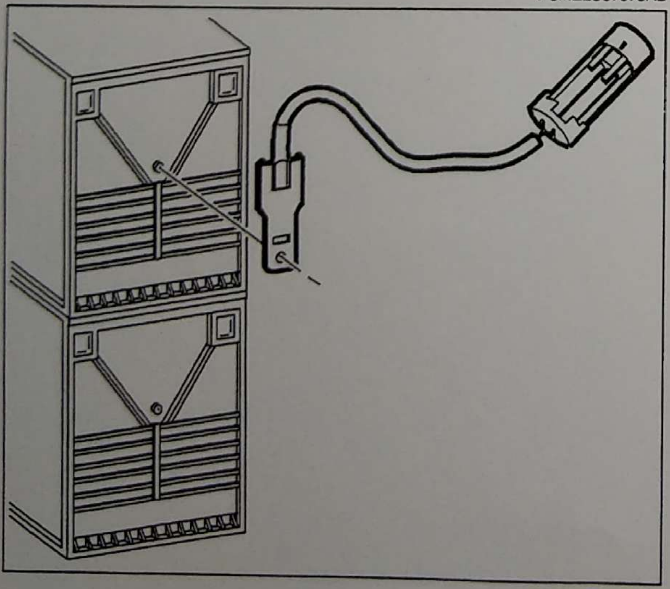
PSMELC67066AB

3. Remove the battery interconnect cables connecting battery terminals at battery module #19 – #20 and #22 – #23. This further breaks down the voltage potential of the battery pack.
4. Locate the battery module with the temperature sensor that requires replacement.
5. Remove the battery module. (Refer to "Battery Module" removal procedure in this manual.)



PSMELC67073AB

6. Unplug the temperature sensor from the wiring harness.
7. Disconnect the temperature sensor from the battery module.



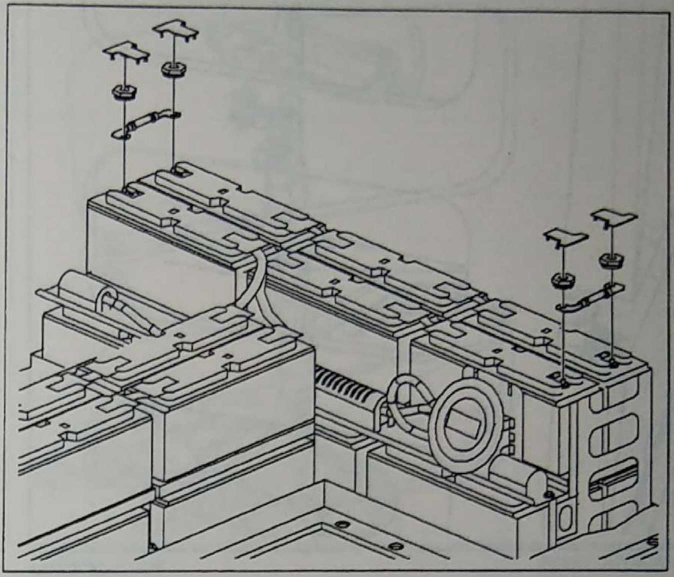
PSMELC67062AA

INSTALLATION

1. Install the temperature sensor to the battery module.
2. Connect the temperature sensor to the wiring harness.
3. Install the battery module (Refer to "Battery Module" installation procedure in this manual.)

4. Install the battery interconnect cables connecting battery terminals at battery modules #19 – #20 and #22 – #23.

5. Visually inspect the pack for pinched/broken vent tubes, wiring etc.



PSMELC67073AB

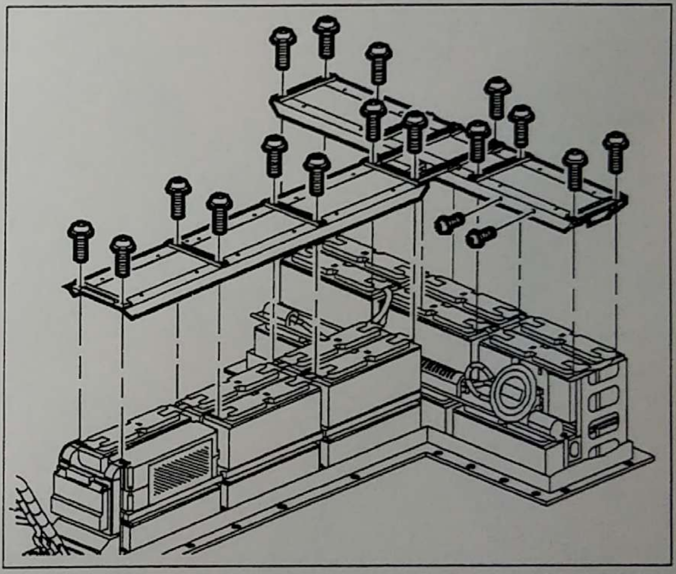
CAUTION: MAKE SURE WHEN INSTALLING THE TOP COVERS THAT THE VENT HARNESS DOES NOT GET PINCHED. PINCHING THE VENT HARNESS MAY CAUSE THE VENT SYSTEM TO FUNCTION INCORRECTLY.

6. Install the battery pack top covers.

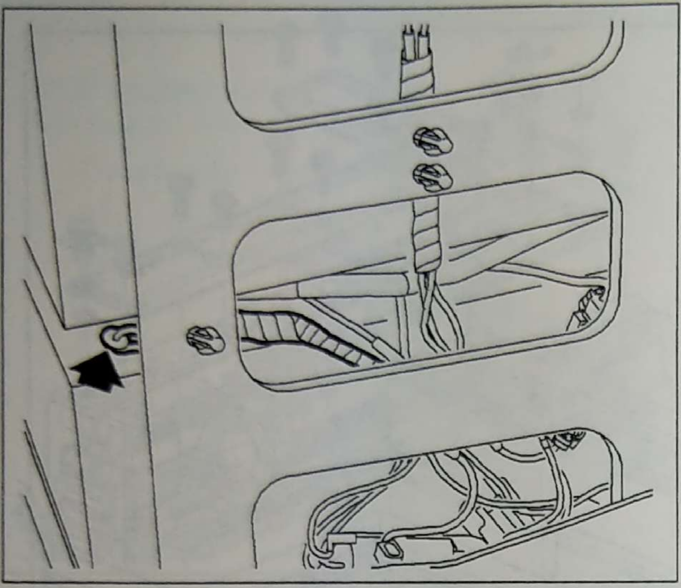
Torque: 10 N•m (89 in-lbs)
(3 N•m ([27 in-lbs]) pack top to manual disconnect)

7. Perform the "Battery Pack" and "Vent Harness" system check procedures. Located in the front ot this section.

8. Install the battery pack. (Refer to "Battery Pack" installation procedure in this manual.)



PSMELC67066AB



PSMELC67064AA

AIR FLOW SENSOR

REMOVAL

1. Remove the battery pack from the vehicle. (Refer to "Battery Pack" removal in this manual.)

CAUTION: WITH THE BATTERY PACK OUT OF THE VEHICLE YOU ARE EXPOSED TO HIGH VOLTAGE. NEVER LEAN ON THE BATTERY PACK OR TOUCH THE BATTERY BACK WITH BOTH HANDS. FOLLOW ALL PROCEDURES STEP BY STEP.

2. Locate the airflow sensor on the right rear, upper H-frame.

3. Remove the airflow sensor by depressing the tabs on the back side of the H-frame and pulling the sensor out.

4. Disconnect the airflow sensor from the wiring harness.

INSTALLATION

1. Connect the wiring harness to the airflow sensor.
2. Push the airflow sensor into place.
3. Perform the battery pack system check procedures.
4. Install the battery pack. (Refer to "Battery Pack" installation procedure in this manual.)

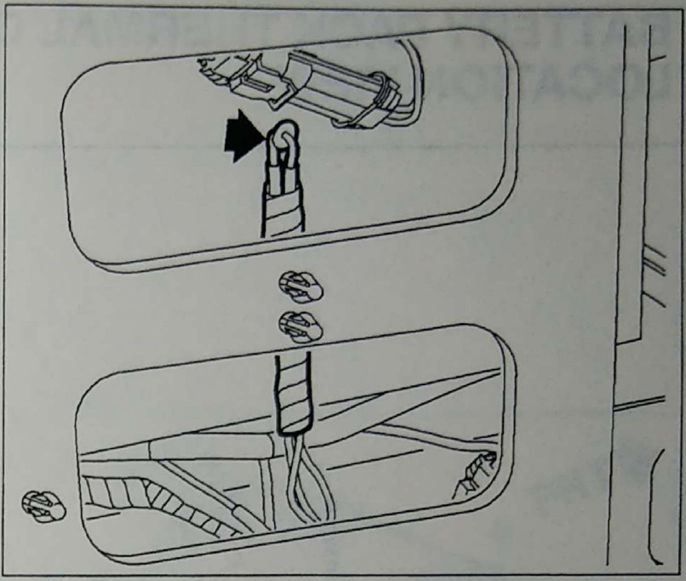
INLET AIR SENSOR

REMOVAL

1. Remove the battery pack from the vehicle. (Refer to "Battery Pack" removal in this manual.)

CAUTION: WITH THE BATTERY PACK OUT OF THE VEHICLE YOU ARE EXPOSED TO HIGH VOLTAGE. NEVER LEAN ON THE BATTERY PACK OR TOUCH THE BATTERY BACK WITH BOTH HANDS. TO PREVENT ARCING NEVER LAY TOOLS ON THE BATTERY PACK. FOLLOW ALL PROCEDURES STEP BY STEP.

2. Locate the inlet air sensor on the right rear, lower H-frame.
3. Remove the inlet air sensor by depressing the tabs on the back side of the H-frame and pulling the sensor out.
4. Disconnect the inlet air sensor from the wiring harness.

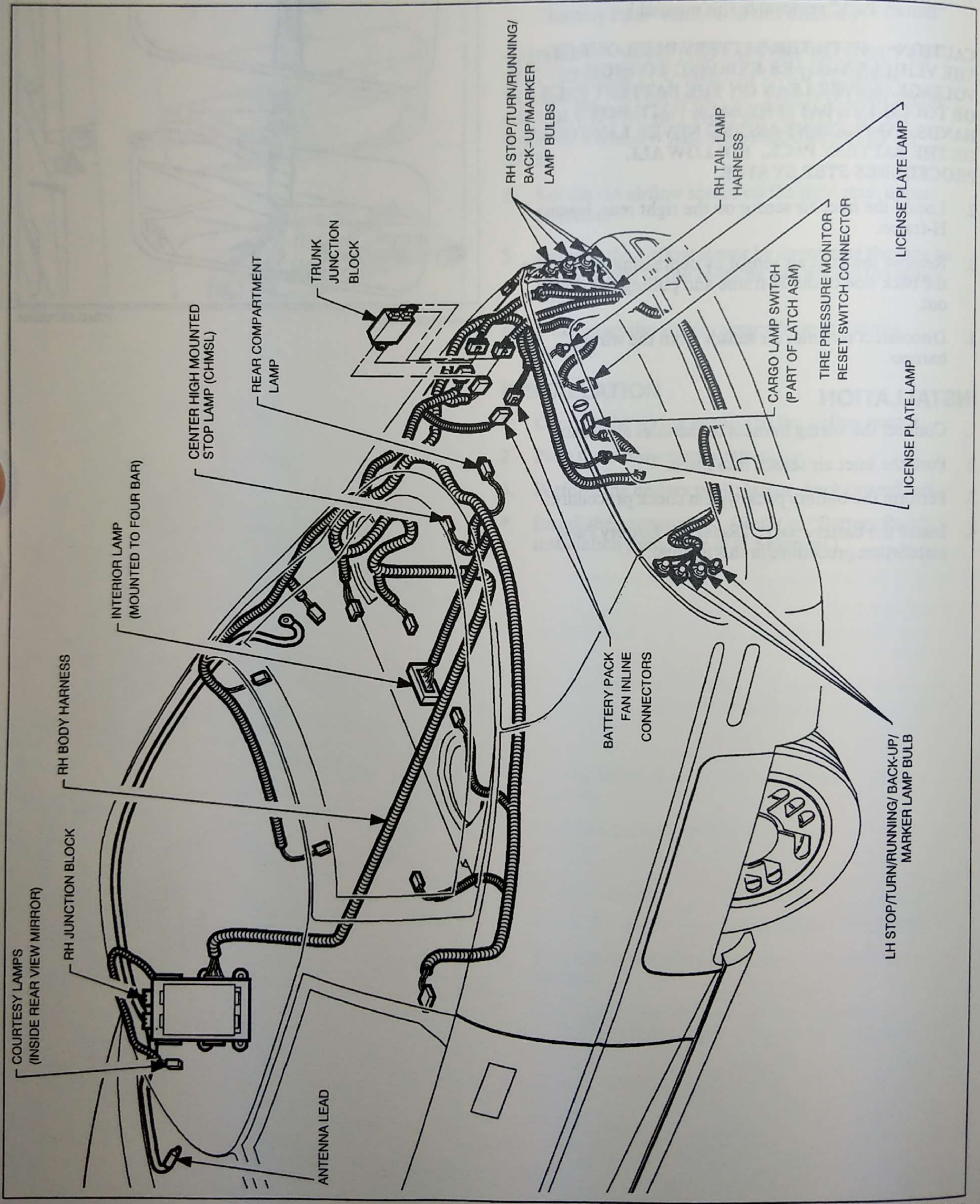


PSMELC67063AA

INSTALLATION

1. Connect the wiring harness to the inlet air sensor.
2. Push the inlet air sensor into place.
3. Perform the battery pack system check procedures.
4. Install the battery pack. (Refer to "Battery Pack" installation procedure in this manual.)

BATTERY PACK THERMAL COOLING COMPONENT LOCATION VIEW

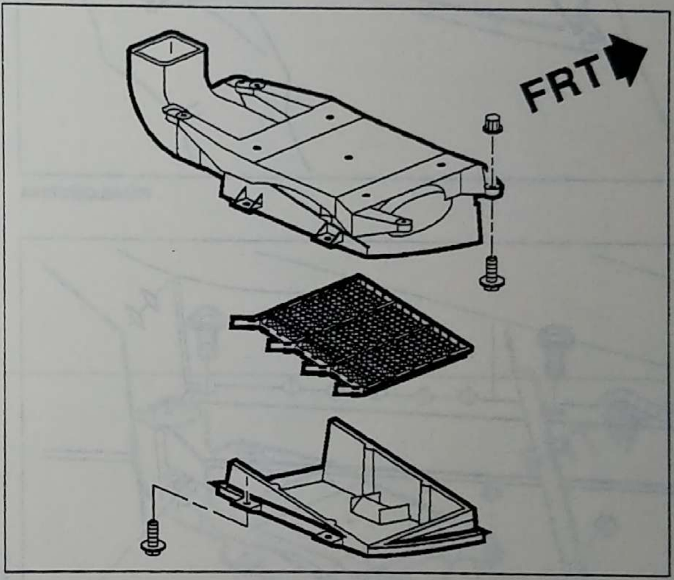

COURTESY LAMPS (INSIDE REAR VIEW MIRROR)
RH JUNCTION BLOCK
RH BODY HARNESS
INTERIOR LAMP (MOUNTED TO FOUR BAR)
CENTER HIGH MOUNTED STOP LAMP (CHMSL)
REAR COMPARTMENT LAMP
TRUNK JUNCTION BLOCK
RH STOP/TURN/RUNNING/ BACK-UP/MARKER LAMP BULBS
RH TAIL LAMP HARNESS
CARGO LAMP SWITCH (PART OF LATCH ASM)
TIRE PRESSURE MONITOR RESET SWITCH CONNECTOR
LICENSE PLATE LAMP
LICENSE PLATE LAMP
BATTERY PACK FAN INLINE CONNECTORS
LH STOP/TURN/RUNNING/ BACK-UP/ MARKER LAMP BULB
ANTENNA LEAD

PSMELC67635AA

BATTERY PACK BLOWER MOTOR

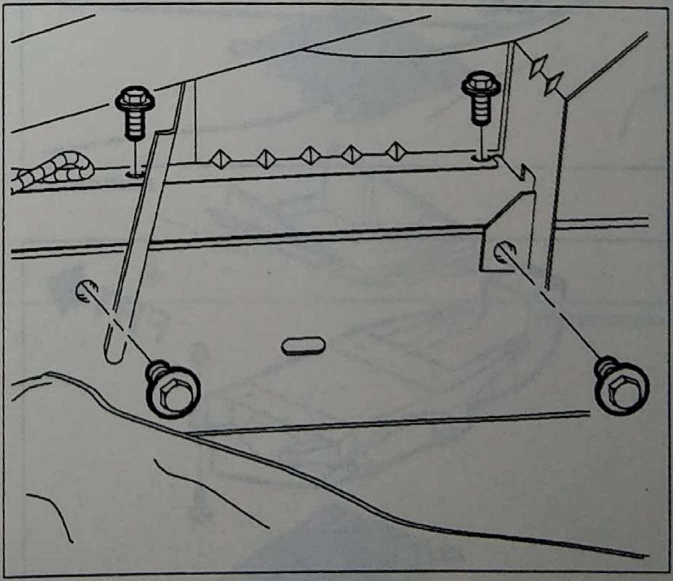
REMOVAL

1. Disable 12 volt system. (Refer to "12 Volt System Disable" procedure in this manual.)
2. Raise vehicle on hoist. (Refer to "Lifting, Jacking and Hoisting" procedure in this manual.)
3. Remove rear air deflector. (Refer to "Rear Air Deflector Removal" procedure in this manual.)
4. Loosen airbox outlet duct clamp at blower motor.
5. Remove air box and duct as an assembly.
6. Remove two harness fasteners from housing.

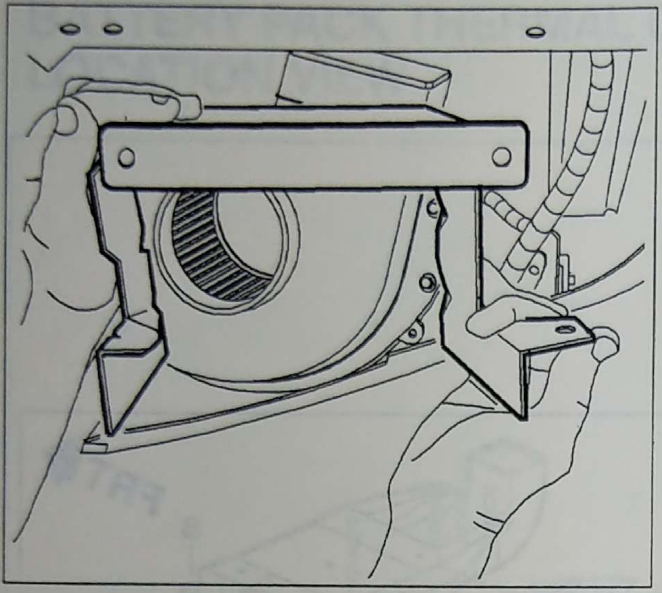


PSMPEN68405AA

7. Remove fasteners holding blower motor bracket.
8. Disconnect electrical connector to blower motor.



PSMELC68380AA



PSMELC68379AA

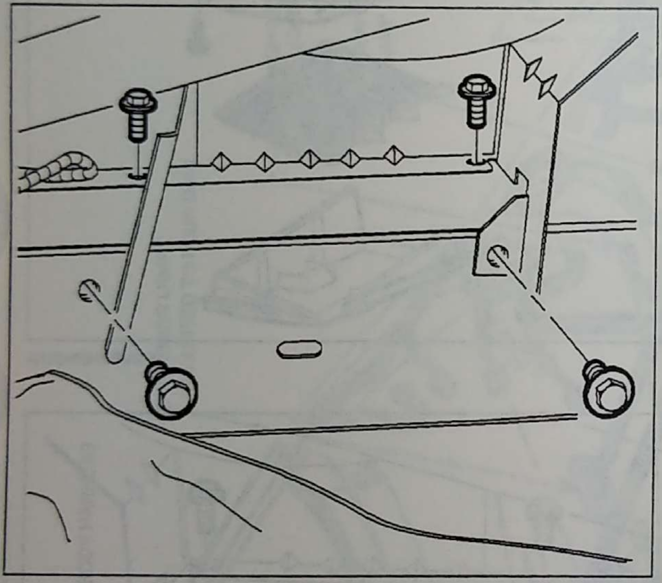
9. Rotate blower motor and bracket assembly out of quarter panel.
10. Remove blower motor housing fasteners from bracket and remove housing.

INSTALLATION

1. Install blower motor housing to support bracket.

Torque: 6 N•m (53 in–lbs)

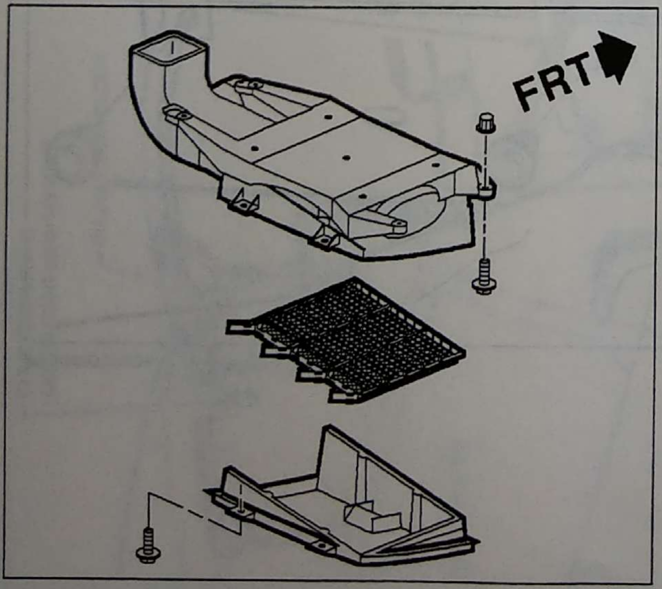
2. Install wiring harness fasteners to blower motor housing.
3. Install electrical connector to motor.
4. Rotate blower motor assembly into rear quarter panel.



PSMELC68380AA

5. Install blower motor bracket fasteners.

Torque: 10 N•m (89 in–lbs)



PSMPEN68405AA

6. Install air box and duct assembly.

Torque: 10 N•m (89 in–lbs)

7. Tighten clamp on airbox outlet hose.

Torque: 3 N•m (27 in–lbs)

8. Install rear air deflector. (Refer to “Rear Air Deflector Installation” procedure in this manual.)
9. Lower Vehicle.
10. Enable 12 volt system. (Refer to “12 Volt System Enable” procedure in this manual.)

BATTERY PACK COOLING BLOWER FILTER

REMOVAL

1. Raise vehicle on hoist. (Refer to “Lifting, Jacking and Hoisting” procedure in this manual.)
2. Remove fastners holding airbox cover to air box housing.
3. Remove air box filter.

INSTALLATION

4. Install air box filter.

IMPORTANT: Make sure the filters are installed correctly as indicated on the filters.

5. Install air box filter cover.

Torque: **6 N•m (53 in–lbs)**

6. Lower Vehicle.

BATTERY PACK COOLING BLOWER AIR BOX ASSEMBLY

REMOVAL

1. Raise vehicle on hoist. (Refer to “Lifting, Jacking and Hoisting” procedure in this manual.)
2. Remove rear air deflector. (Refer to “Rear Air Deflector Removal” procedure in this manual.)
3. Loosen airbox outlet duct clamp at blower motor.
4. Remove air box fasteners.
5. Remove air box and duct as an assembly.

INSTALLATION

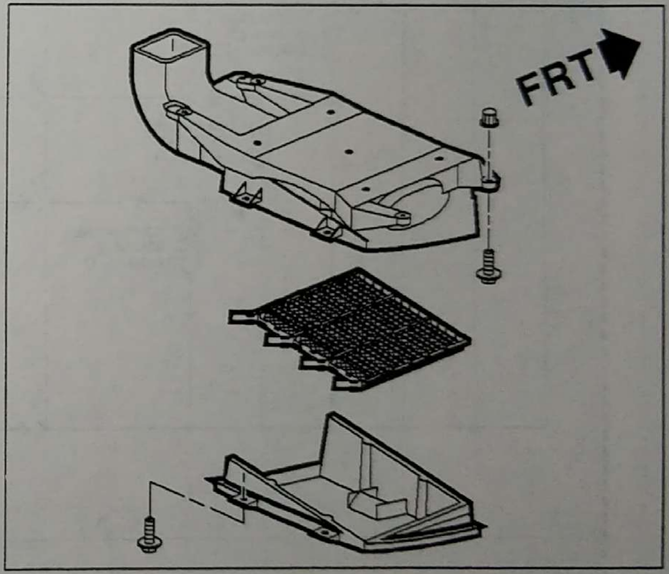
1. Install air box and duct assembly.

Torque: **10 N•m (89 in–lbs)**

2. Tighten clamp on airbox outlet duct.

Torque: **3 N•m (27 in–lbs)**

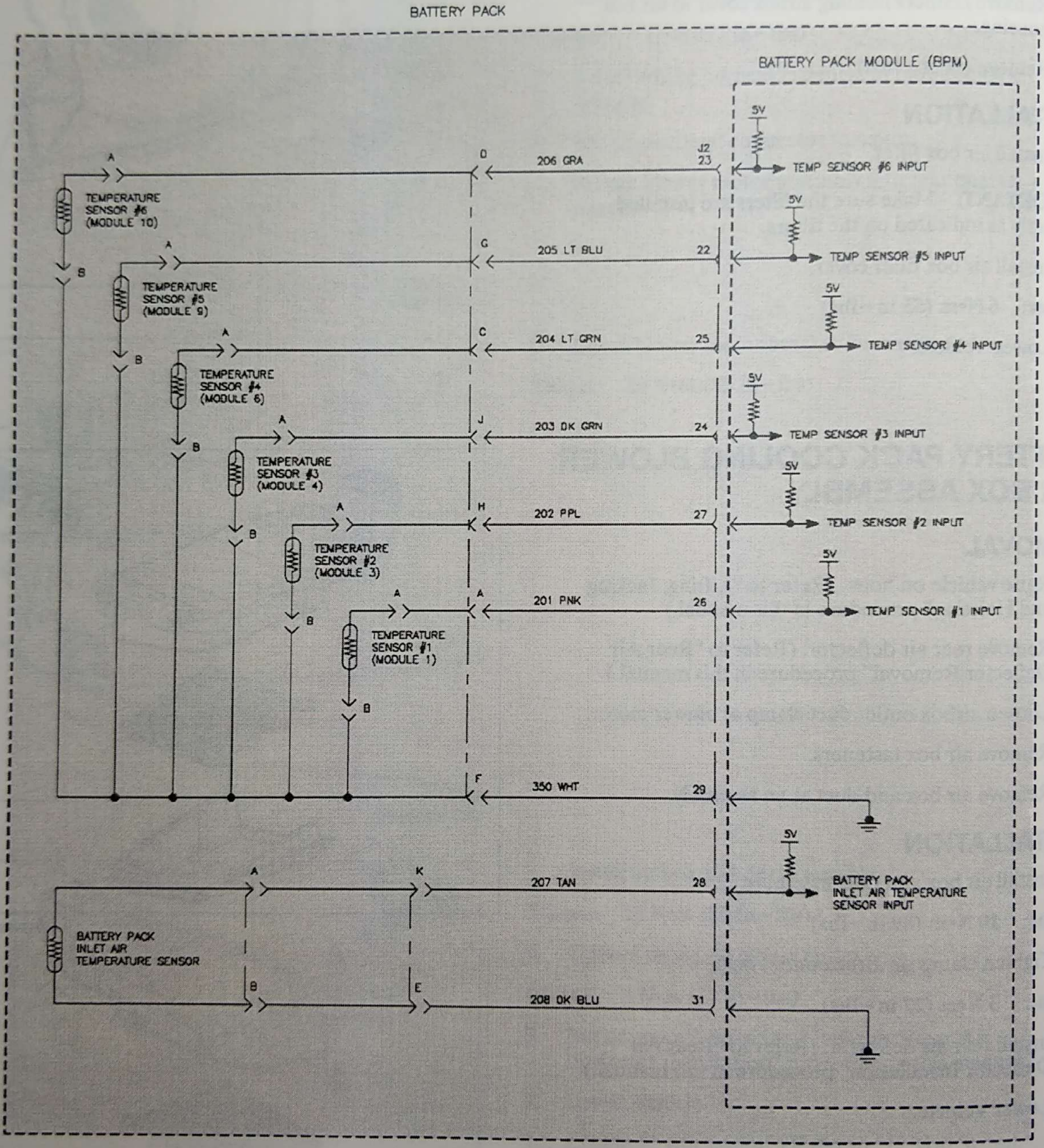
3. Install rear air deflector. (Refer to “Rear Air Deflector Installation” procedure in this manual.)
4. Lower Vehicle.



PSMPEN68405AA

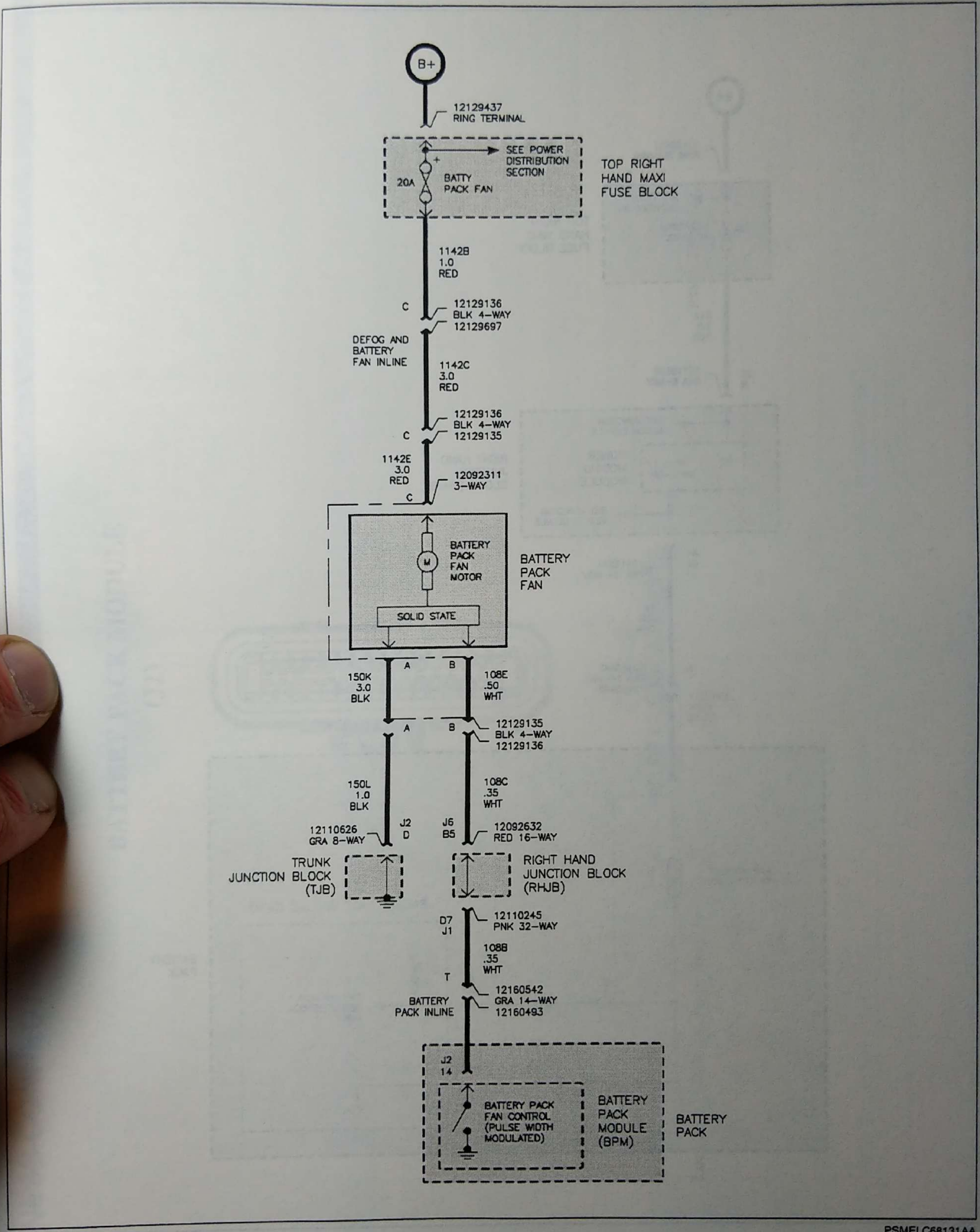
CS CamScanner

BATTERY PACK


BATTERY PACK
BATTERY PACK MODULE (BPM)
5V
J2
23
TEMP SENSOR #6 INPUT
206 GRA
D
A
B
TEMPERATURE SENSOR #6 (MODULE 10)
5V
TEMP SENSOR #5 INPUT
205 LT BLU
22
G
TEMPERATURE SENSOR #5 (MODULE 9)
5V
TEMP SENSOR #4 INPUT
204 LT GRN
25
C
TEMPERATURE SENSOR #4 (MODULE 6)
5V
TEMP SENSOR #3 INPUT
203 DK GRN
24
J
TEMPERATURE SENSOR #3 (MODULE 4)
5V
TEMP SENSOR #2 INPUT
202 PPL
27
H
TEMPERATURE SENSOR #2 (MODULE 3)
5V
TEMP SENSOR #1 INPUT
201 PNK
26
TEMPERATURE SENSOR #1 (MODULE 1)
F
350 WHT
29
5V
BATTERY PACK INLET AIR TEMPERATURE SENSOR INPUT
K
207 TAN
28
BATTERY PACK INLET AIR TEMPERATURE SENSOR
E
208 DK BLU
31

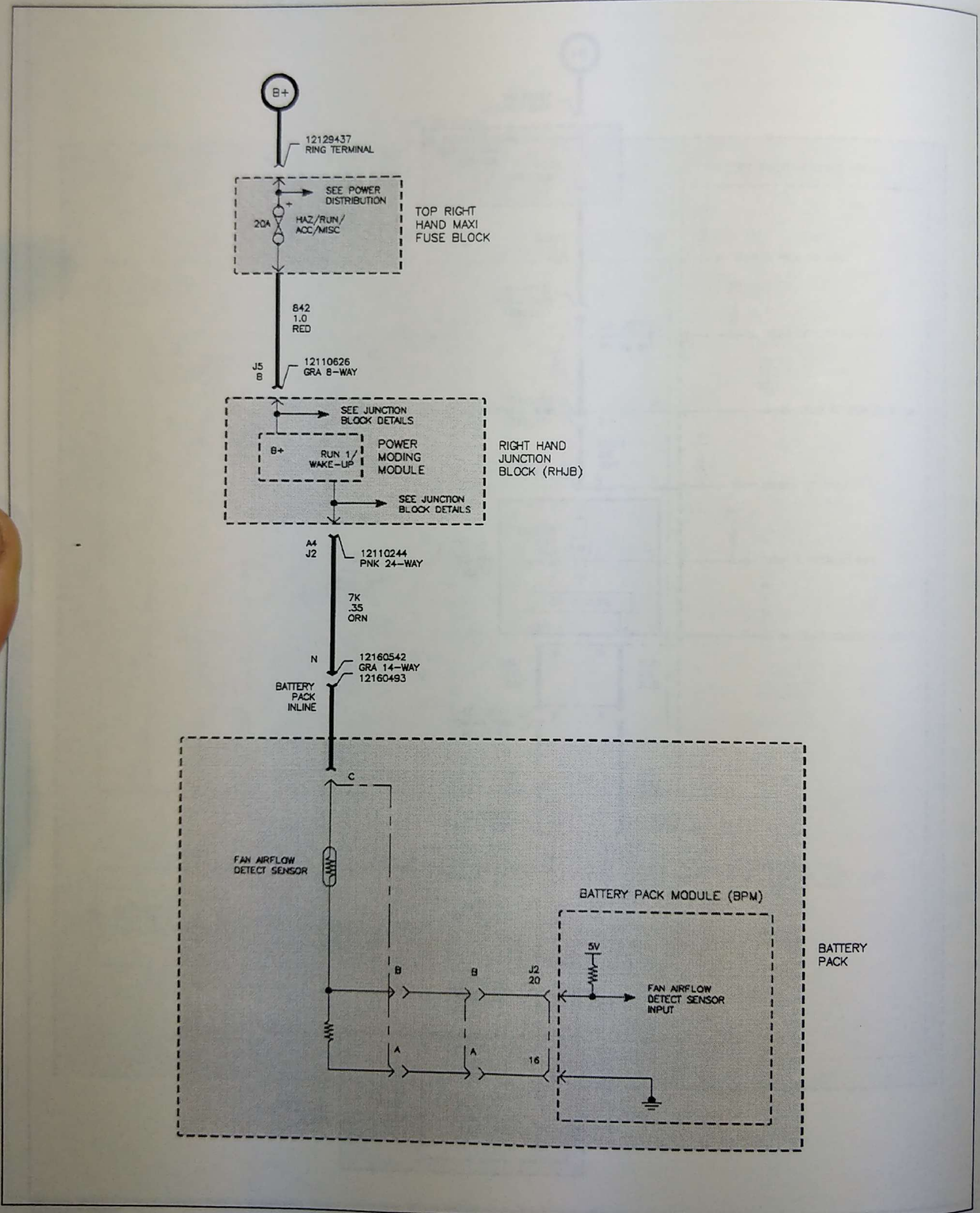
PSMELC68121AB

BATTERY PACK THERMAL COOLING


B+
12129437
RING TERMINAL
SEE POWER DISTRIBUTION SECTION
20A
BATTY PACK FAN
TOP RIGHT HAND MAXI FUSE BLOCK
1142B
1.0
RED
C
12129136
BLK 4–WAY
12129697
DEFOG AND BATTERY FAN INLINE
1142C
3.0
RED
12129136
BLK 4–WAY
12129135
C
1142E
3.0
RED
12092311
3–WAY
C
M
BATTERY PACK FAN MOTOR
SOLID STATE
BATTERY PACK FAN
A
B
150K
3.0
BLK
108E
.50
WHT
A
B
12129135
BLK 4–WAY
12129136
150L
1.0
BLK
108C
.35
WHT
12110626
GRA 8–WAY
J2
D
J6
B5
12092632
RED 16–WAY
TRUNK JUNCTION BLOCK (TJB)
RIGHT HAND JUNCTION BLOCK (RHJB)
D7
J1
12110245
PNK 32–WAY
108B
.35
WHT
T
BATTERY PACK INLINE
12160542
GRA 14–WAY
12160493
J2
14
BATTERY PACK FAN CONTROL (PULSE WIDTH MODULATED)
BATTERY PACK MODULE (BPM)
BATTERY PACK

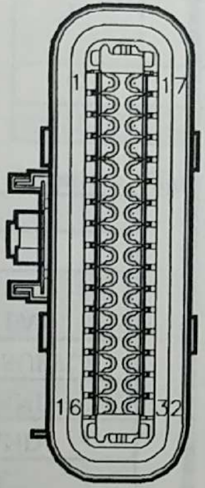
PSMELC68131AA

BATTERY PACK THERMAL COOLING


B+
12129437
RING TERMINAL
SEE POWER
DISTRIBUTION
20A
HAZ/RUN/
ACC/MISC
TOP RIGHT
HAND MAXI
FUSE BLOCK
842
1.0
RED
J5
8
12110626
GRA 8-WAY
SEE JUNCTION
BLOCK DETAILS
B+
RUN 1/
WAKE-UP
POWER
MODING
MODULE
RIGHT HAND
JUNCTION
BLOCK (RHJB)
SEE JUNCTION
BLOCK DETAILS
A4
J2
12110244
PNK 24-WAY
7K
.35
ORN
N
12160542
GRA 14-WAY
12160493
BATTERY
PACK
INLINE
C
FAN AIRFLOW
DETECT SENSOR
BATTERY PACK MODULE (BPM)
5V
B
B
J2
20
FAN AIRFLOW
DETECT SENSOR
INPUT
A
A
16
BATTERY
PACK

PSMELC68120AB

BATTERY PACK MODULE
(J2)



12129025
WITH CLEAR RETAINER

Location: Underbody, in Battery Pack

PSMELC68238AA

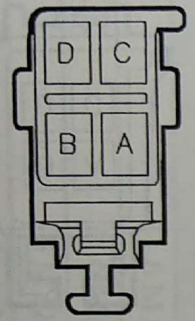
HARNESS CONNECTOR FACES

BATTERY PACK MODULE – J2 – 12129025 (WITH RETAINER)

CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
1	WHT			GROUND
2	PNK			RUN 1
3	GRA			B+
4	DK BLU			VEHICLE WAKE–UP
5				
6				
7	BLK			PARK SELECT
8	BLK			AD STATE “A”
9	LT BLU			AD STATE “B”
10	BRN			AD STATE “C”
11	DK GRN			AD COMMAND
12	WHT			APS COMMAND
13	PNK			AD POWER SUPPLY
14	TAN			BATT PACK FAN CONTROL
15			–	–
16	YEL			GROUND
17	–	–	–	–
18	GRA			CHARGE RECEPT TEMP
19	–	–	–	–
20	BLK			AIRFLOW DETECT INPUT
21	–	–	–	–
22	LT BLU			MODULE 9 TEMP
23	GRA			MODULE 10 TEMP
24	DK GRN			MODULE 4 TEMP
25	LT GRN			MODULE 6 TEMP
26	PNK			MODULE 1 TEMP
27	PPL			MODULE 3 TEMP
28	TAN			INLET AIR TEMP
29	WHT			GROUND
30	ORN			CLASS 2 DATA
31	DK BLU			GROUND
32	DK GRN			SERIAL DATA

HARNESS CONNECTOR FACES

BATTERY PACK FAN INLINE – FEMALE CONNECTOR



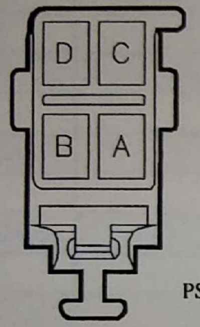
BLACK
12129136

BATTERY PACK FAN INLINE – 12129136				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	BLK	150L	1.0	GROUND
B	WHT	108C	.35	BATTERY PACK FAN CONTROL
C	RED	1142C	3.0	B+
D				

Location: Right Side of Trunk Compartment, Under Carpet

HARNESS CONNECTOR FACES

DEFOGGER AND BATTERY PACK FAN INLINE – FEMALE CONNECTOR

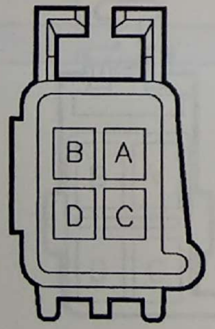


BLACK
12129136

DEFOGGER AND BATTERY PACK FAN INLINE – 12129136				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	RED	1242A	1.0	PRIMARY DEFOG B+
B	RED	1342A	1.0	SECONDARY DEFOG B+
C	RED	1142B	1.0	BATTERY PACK FAN MOTOR B+
D				

Location: Passenger Compartment, Right Side of I/P Above Junction Block

DEFOGGER AND BATTERY PACK FAN INLINE – MALE CONNECTOR



BLACK
12129135

DEFOGGER AND BATTERY PACK FAN INLINE – 12129135				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	RED	1242B	2.0	PRIMARY DEFOG B+
B	RED	1342B	3.0	SECONDARY DEFOG B+
C	RED	1142C	3.0	BATTERY PACK FAN MOTOR B+
D				

Location: Passenger Compartment, Right Side of I/P Above Junction Block

AUTO DISCONNECT (AD)

The auto disconnect contains a controller, two high voltage relays, two high watt resistors (resistors part of wiring harness) and a wiring harness. The auto disconnects primary function is to detect a malfunction in the high voltage system and open the relays disconnecting the high voltage from underhood. When the AD detects a failure and opens the relays it reports the failure via three state lines (wires) to the battery pack module (BPM) who will set and store the diagnostic trouble code. When the vehicle is operating normally the relays will remain closed unless a failure is detected or the manual disconnect knob has been turned. The normal operating condition for the relays is the closed position. The relays will remain closed even if the vehicle is placed in the lock position unless a failure has been detected.

When a failure is detected, with the exception of an isolation failure or a BPM command to open the relays the auto disconnect will open the relays disabling propulsion. If an isolation failure is detected the AD will inform the BPM and if the vehicle speed is greater than 1 km/h (1 KPH on Scan tool) the BPM will not allow the AD to open the relays. When vehicle speed is less than 1 km/h (1 KPH on Scan tool) for three minutes or the vehicle is placed in park for 10 seconds the BPM will allow the AD to open the relays. Additionally if the BPM detects a low pack state of charge (PSOC), severe under or over voltage the BPM will command the AD to open the relays when the above speed criteria is met.

The only other time the relays will open is when the manual disconnect knob is turned. Located in the manual disconnect housing is a micro-switch which is part of the interlock loop circuit. When the knob is turned the switch contacts are opened causing an interlock loop failure which opens the relays.

PRECHARGE

To close the relays the AD system goes through a precharge. Precharge allows closing of the positive bus relay with a small voltage potential to prevent arcing. A precharge capacitor is located in the power inverter module (PIM). When the vehicle is placed in the Run mode, and the relays are open, the negative bus relay and the precharge (low current) relay in the AD controller will close allowing the PIM capacitor to charge. Precharge will occur until a voltage of 90 percent of battery pack voltage has been reached. At this time the positive bus relay will close and the precharge (low current) relay in the AD controller will open allowing normal system operation. The AD will charge the PIM capacitor to 90 percent of battery pack voltage within seven seconds and pack current from the low current relay will be no greater than three amps. If precharge has not been completed within 10 seconds then a precharge fault will occur and all relays will be commanded open and the "Wait" telltale will be displayed on the instrument panel.

ISOLATION DETECTION

High voltage is isolated (resistance measured to chassis ground) from chassis ground. The AD shall check for a loss of isolation to ground of either the high voltage negative or the high voltage positive leads. This shall be accomplished by measuring the voltage between chassis ground and each of the high voltage leads and looking for an imbalance, less than 30 percent or greater than 70 percent of the pack voltage. If the voltage does not fall within the above limits an isolation failure is set.

Each high voltage component must maintain a specified amount of isolation from chassis ground.

COMPONENT	RESISTANCE TO CHASSIS GROUND
PEB	1.6 M Ω
BATTERY PACK	1.6 M Ω
P/S MOTOR	5 M Ω
AC COMPRESSOR MOTOR	5 M Ω

The sum of all high voltage components must be greater than 600K ohms when measured to chassis ground. All of the components resistance are taken in parallel.

The relays will open if the vehicle is in park, however if vehicle speed is greater than 1 km/h (1 KPH on Scan tool) the BPM will inhibit opening of the relays until 1 km/h (1 KPH on Scan tool) is reached or the vehicle is placed in the Park position.

INTERLOCK LOOP

The interlock loop is a low voltage circuit that runs parallel with the high voltage circuits. The interlock loop runs through all of the high voltage connectors allowing the auto disconnect (AD) to detect a disconnect of a high voltage component. The AD accomplishes this by applying 7.9 – 10.6 volts to the interlock loop circuit to check for a continuous loop. If a continuous loop is present the AD will monitor this voltage for a voltage drop. If a voltage between 0–2.0 volts is detected the AD will open the relays and report this information to the BPM. Normal interlock loop voltage is 3.2 to 7.3 volts.

CHASSIS GROUND

The AD chassis ground signal provides chassis ground reference for the AD isolation protection. The AD monitors this line for continuity. If the wire is open the AD can no longer detect loss of isolation. The AD will terminate all functions and open the high voltage relays. This information will be reported to the battery pack module (BPM) via the state lines.

GROUND SENSE

The ground sense power signal provides the interior ground reference for the AD isolation protection. The AD monitors this line for continuity. If the wire is open the AD can no longer detect loss of isolation. The AD will terminate all functions and open the high voltage relays. This information will be reported to the BPM via the state lines.

LOW PACK VOLTAGE

The AD board shall be capable of operating at a voltage as low as 182 volts. If a battery pack voltage of less than 182 volts is detected by the AD, a low voltage fault will set within 10 milliseconds. The relays will be commanded open and the interlock voltage will be removed.

STATE LINES

There are three state lines (wires) that run between the BPM and the AD. These state lines are used to report fault information to the BPM. This is accomplished by pulling the lines high or low in different sequences and each sequences identifies a different failure. The AD reports the information to the BPM and the BPM will set the DTC and turn on the telltale. There is a fourth line that runs from the BPM to the AD. This line is used by the BPM under certain conditions to prevent the AD from opening the relays. Below is a list defining the different states of the AD state lines.

STATUS	LINE 1	LINE 2	LINE 3	AD PWR SUPPLY
OK	0V	0V	0V	5V
LOSS OF ISOLATION	5V	5V	5V	5V
GROUND LOSS	5V	5V	0V	5V
INTERLOCK	0V	5V	5V	5V
LOW PACK VOLTAGE	5V	0V	5V	5V
BPM COMMANDED OPEN	0V	5V	0V	5V
CAPACITOR PRECHARGE	5V	0V	0V	5V
CAPACITOR PRECHARGE FAIL	0V	0V	5V	5V

HIGH VOLTAGE RELAYS

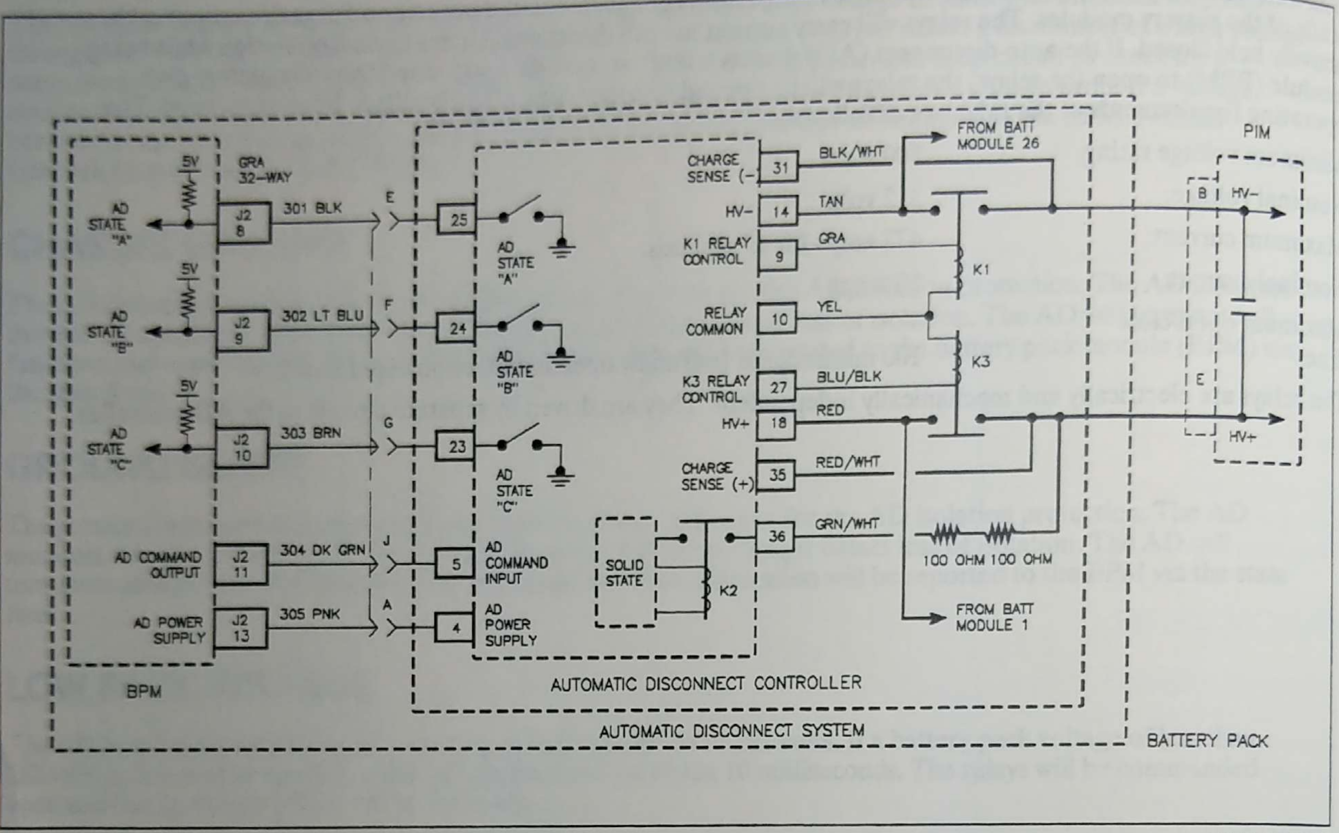
The auto disconnect system contains two high voltage relays connected to the positive and negative output cable leads of the battery modules. The relays will carry current in both directions. Under normal operation while being actively held closed. If the auto disconnect (AD) detects a fault or receives a command from the battery pack module (BPM) to open the relays, the relays will be opened disconnecting all high voltage from underhood. The operating requirements of the relay are as follows:

Minimum voltage rating	500 volts
Nominal voltage:	312 volts
Maximum current:	472 amps for 15 seconds.
Nominal current:	50 amps
Maximum open/close time:	100 milliseconds (normally open in the un-powered state).

The relays are electrically and mechanically independent. They are driven by separate circuits in the AD controller.

CS CamScanner

DTC 272 – AUTO DISCONNECT CLOSURE FAULT


5V
GRA
32–WAY
AD
STATE
"A"
J2
8
301 BLK
E
25
AD
STATE
"A"
5V
AD
STATE
"B"
J2
9
302 LT BLU
F
24
AD
STATE
"B"
5V
AD
STATE
"C"
J2
10
303 BRN
G
23
AD
STATE
"C"
AD COMMAND
OUTPUT
J2
11
304 DK GRN
J
5
AD
COMMAND
INPUT
AD POWER
SUPPLY
J2
13
305 PNK
A
4
AD
POWER
SUPPLY
SOLID
STATE
K2
BPM
CHARGE
SENSE (–)
31
BLK/WHT
FROM BATT
MODULE 26
HV–
14
TAN
K1 RELAY
CONTROL
9
GRA
K1
RELAY
COMMON
10
YEL
K3 RELAY
CONTROL
27
BLU/BLK
K3
HV+
18
RED
CHARGE
SENSE (+)
35
RED/WHT
36
GRN/WHT
100 OHM 100 OHM
FROM BATT
MODULE 1
AUTOMATIC DISCONNECT CONTROLLER
AUTOMATIC DISCONNECT SYSTEM
BATTERY PACK
PIM
B
HV–
E
HV+

PSMELC68201AA

AUTO DISCONNECT CLOSURE FAULT

When the auto disconnect is open and vehicle is placed in the Run mode, the auto disconnect controller will attempt to close the relays allowing power to the power inverter module (PIM) for propulsion.

DTC PARAMETERS

This DTC will set anytime two unsuccessful attempts have been made in five minutes to close the auto disconnect relays with a failure present for 10 seconds.

ACTION TAKEN

The DTC is set, the WAIT and SERVICE NOW telltales are illuminated and propulsion is disabled.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 273-280.

TELLTALE ILLUMINATED

WAIT and SERVICE NOW

DIAGNOSTIC AIDS

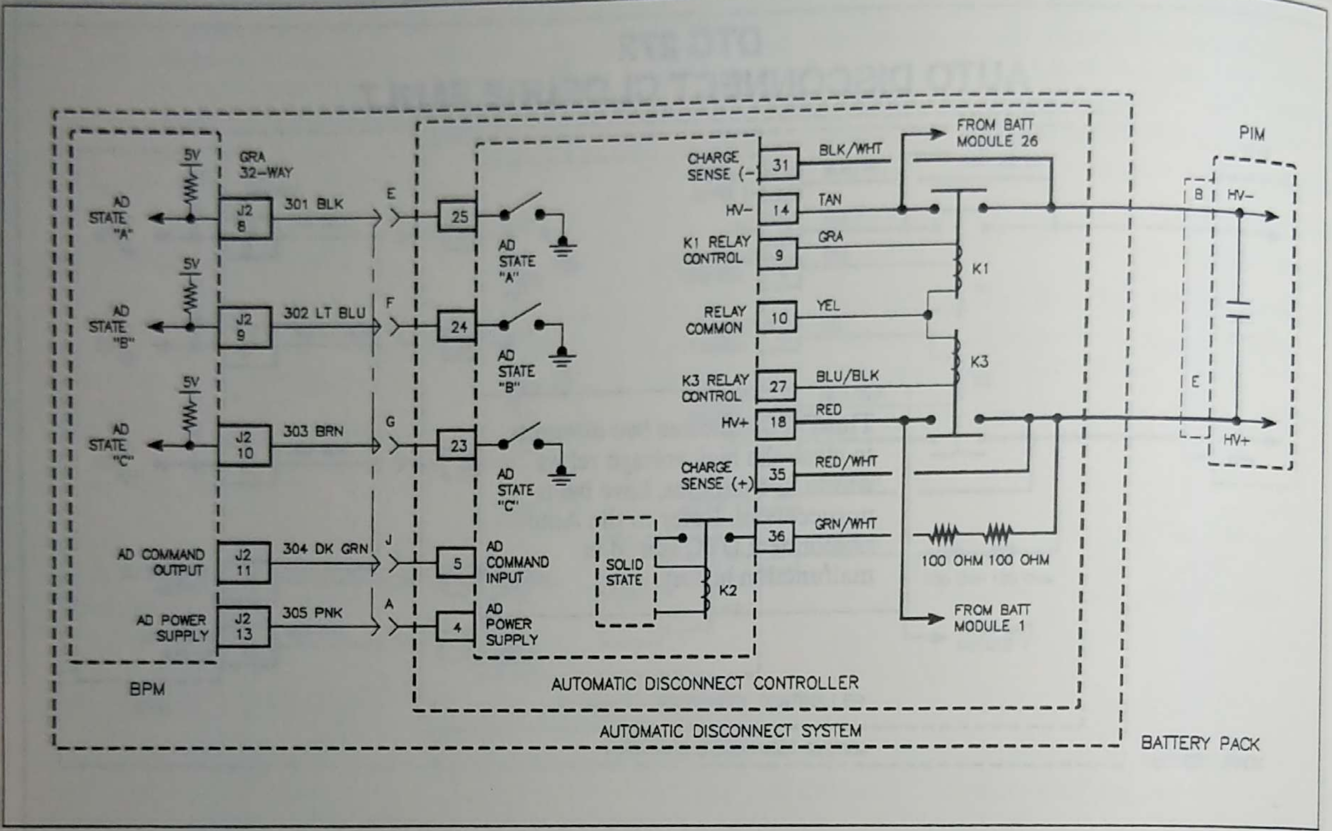
This DTC will always be set with one of the battery pack module (BPM) auto disconnect DTCs. This DTC just informs that two attempts within five minutes to close the high voltage relays has been made.

If this DTC is set and no other DTCs are set check the AD state lines between the BPM and AD.

DTC 272
AUTO DISCONNECT CLOSURE FAULT

This DTC indicates two attempts to close the high voltage relays within five minutes, have been unsuccessful. Refer to the Auto Disconnect DTC stored in malfunction history.

DTC 273 – AUTO DISCONNECT (AD) PRE-CHARGE FAULT


5V
GRA
32-WAY
AD STATE "A"
J2 8
301 BLK
E
25
AD STATE "A"
5V
AD STATE "B"
J2 9
302 LT BLU
F
24
AD STATE "B"
5V
AD STATE "C"
J2 10
303 BRN
G
23
AD STATE "C"
AD COMMAND OUTPUT
J2 11
304 DK GRN
J
5
AD COMMAND INPUT
AD POWER SUPPLY
J2 13
305 PNK
A
4
AD POWER SUPPLY
SOLID STATE
K2
BPM
CHARGE SENSE (-)
31
BLK/WHT
HV-
14
TAN
K1 RELAY CONTROL
9
GRA
K1
RELAY COMMON
10
YEL
K3
K3 RELAY CONTROL
27
BLU/BLK
HV+
18
RED
CHARGE SENSE (+)
35
RED/WHT
36
GRN/WHT
100 OHM 100 OHM
FROM BATT MODULE 26
FROM BATT MODULE 1
PIM
B
HV-
E
HV+
AUTOMATIC DISCONNECT CONTROLLER
AUTOMATIC DISCONNECT SYSTEM
BATTERY PACK

PSMELC68201AA

AUTO DISCONNECT (AD) PRE-CHARGE FAULT

When the vehicle is placed in the Run mode (with relays open) the power inverter module (PIM) capacitor precharge is initiated. The negative relay is closed and a (low current) precharge relay in the AD is closed allowing the capacitor to charge to 90% of battery pack voltage. At this time the positive high voltage (HV) relay is closed and the precharge (low current) relay is opened and battery pack voltage is available for propulsion.

DTC PARAMETERS

This DTC will set anytime pre-charging the high voltage bus takes longer than 15 seconds.

ACTION TAKEN

The DTC is set and the WAIT telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 272

TELLTALE ILLUMINATED

WAIT

DIAGNOSTIC AIDS

The status of the AD state lines is:

A = 0 Volts

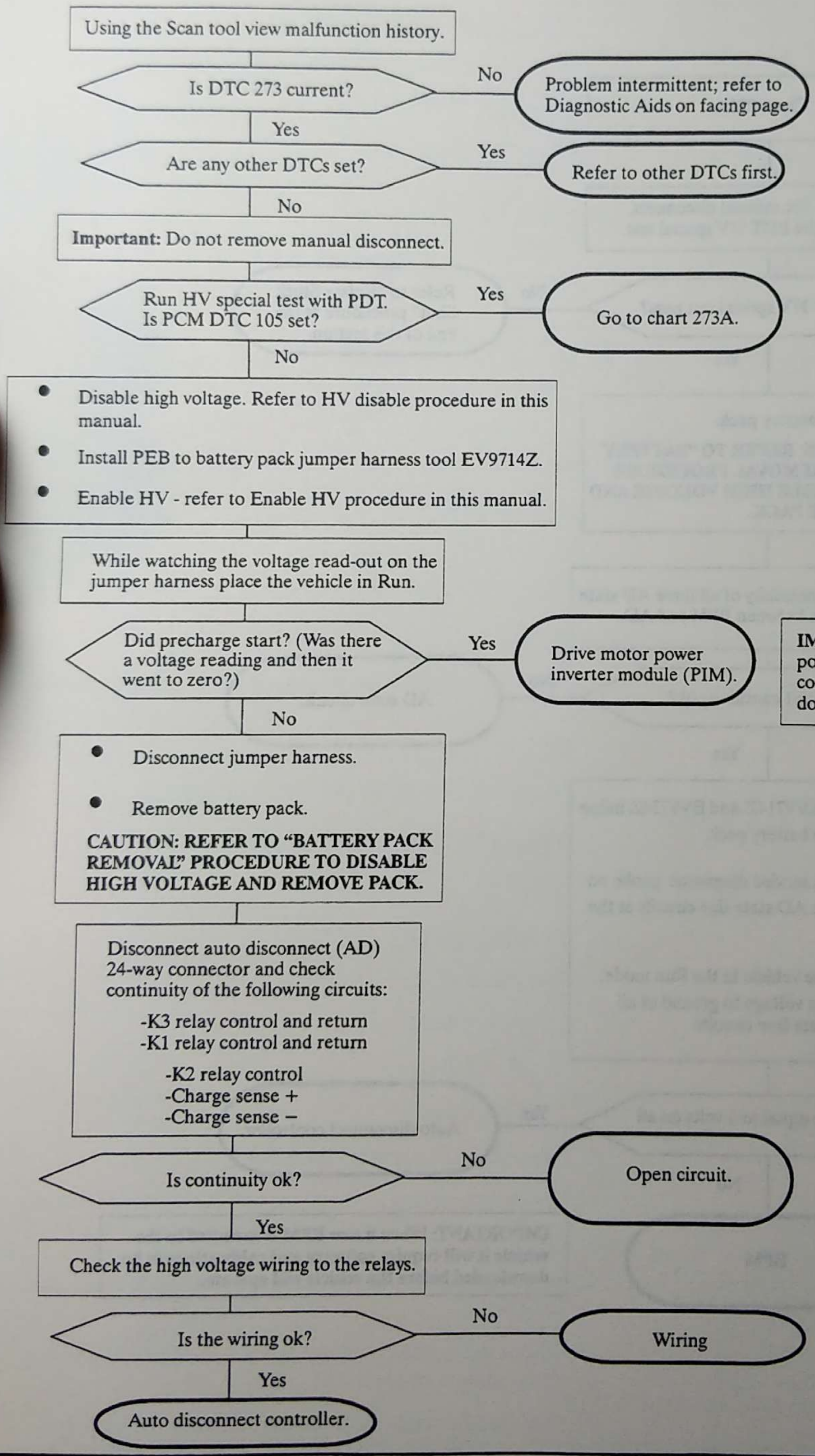
B = 0 Volts

C = 5 Volts

The AD pulls the state lines low.

The AD will fail precharge if the relays are stuck shut.

DTC 273
AUTO DISCONNECT (AD) PRE-CHARGE FAULT


Using the Scan tool view malfunction history.
Is DTC 273 current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any other DTCs set?
Yes
Refer to other DTCs first.
No
Important: Do not remove manual disconnect.
Run HV special test with PDT. Is PCM DTC 105 set?
Yes
Go to chart 273A.
No
• Disable high voltage. Refer to HV disable procedure in this manual.
• Install PEB to battery pack jumper harness tool EV9714Z.
• Enable HV - refer to Enable HV procedure in this manual.
While watching the voltage read-out on the jumper harness place the vehicle in Run.
Did precharge start? (Was there a voltage reading and then it went to zero?)
Yes
Drive motor power inverter module (PIM).
No
• Disconnect jumper harness.
• Remove battery pack.
CAUTION: REFER TO "BATTERY PACK REMOVAL" PROCEDURE TO DISABLE HIGH VOLTAGE AND REMOVE PACK.
Disconnect auto disconnect (AD) 24-way connector and check continuity of the following circuits:
-K3 relay control and return
-K1 relay control and return
-K2 relay control
-Charge sense +
-Charge sense –
Is continuity ok?
No
Open circuit.
Yes
Check the high voltage wiring to the relays.
Is the wiring ok?
No
Wiring
Yes
Auto disconnect controller.

IMPORTANT: When a new drive motor power inverter module is installed the correct software and calibration must be downloaded before vehicle will operate.

DTC 273A

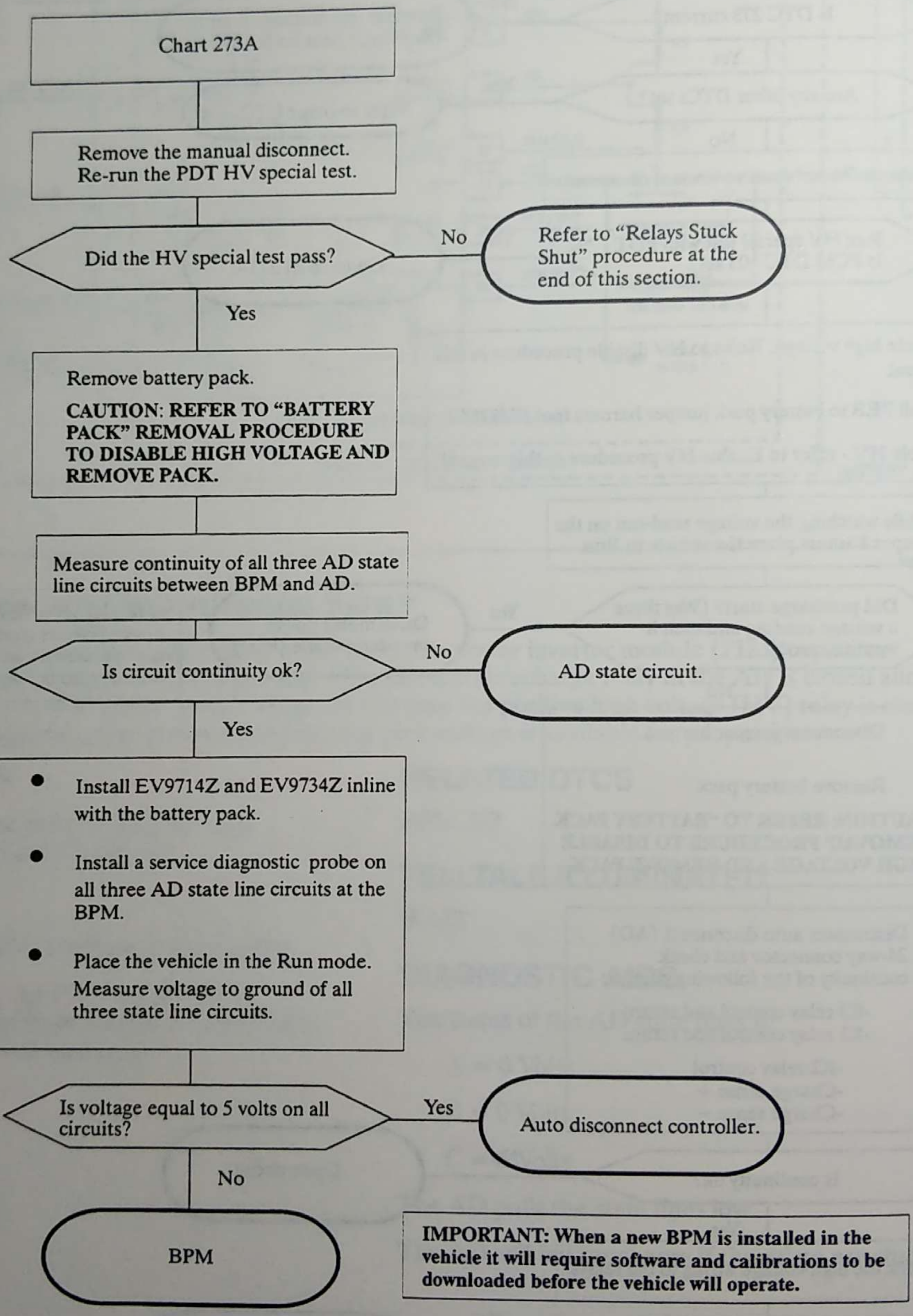
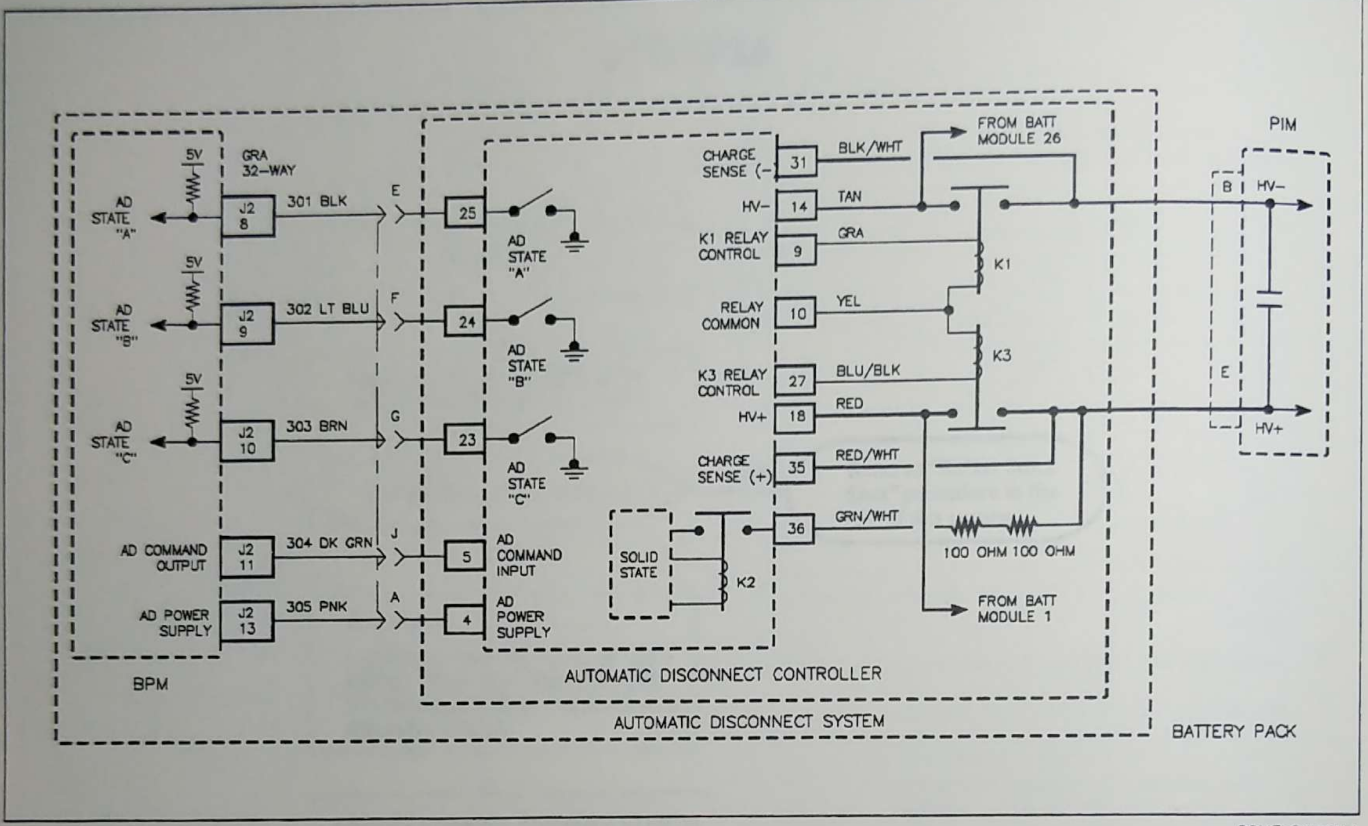


Chart 273A
Remove the manual disconnect. Re-run the PDT HV special test.
Did the HV special test pass?
No
Refer to "Relays Stuck Shut" procedure at the end of this section.
Yes
Remove battery pack.
CAUTION: REFER TO "BATTERY PACK" REMOVAL PROCEDURE TO DISABLE HIGH VOLTAGE AND REMOVE PACK.
Measure continuity of all three AD state line circuits between BPM and AD.
Is circuit continuity ok?
No
AD state circuit.
Yes
Install EV9714Z and EV9734Z inline with the battery pack.
Install a service diagnostic probe on all three AD state line circuits at the BPM.
Place the vehicle in the Run mode. Measure voltage to ground of all three state line circuits.
Is voltage equal to 5 volts on all circuits?
Yes
Auto disconnect controller.
No
BPM

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 274 – AUTO DISCONNECT RELAYS COMMANDED OPEN


5V
GRA 32-WAY
AD STATE "A"
J2 8
301 BLK
E
5V
AD STATE "B"
J2 9
302 LT BLU
F
5V
AD STATE "C"
J2 10
303 BRN
G
AD COMMAND OUTPUT
J2 11
304 DK GRN
J
AD POWER SUPPLY
J2 13
305 PNK
A
BPM
25
AD STATE "A"
24
AD STATE "B"
23
AD STATE "C"
5
AD COMMAND INPUT
4
AD POWER SUPPLY
SOLID STATE
K2
CHARGE SENSE (-)
31
BLK/WHT
FROM BATT MODULE 26
HV-
14
TAN
K1 RELAY CONTROL
9
GRA
K1
RELAY COMMON
10
YEL
K3
K3 RELAY CONTROL
27
BLU/BLK
HV+
18
RED
CHARGE SENSE (+)
35
RED/WHT
36
GRN/WHT
100 OHM 100 OHM
FROM BATT MODULE 1
PIM
B
HV-
E
HV+
AUTOMATIC DISCONNECT CONTROLLER
AUTOMATIC DISCONNECT SYSTEM
BATTERY PACK

PSMELC68201AA

AUTO DISCONNECT RELAYS COMMANDED OPEN

The battery pack module (BPM) will command the auto disconnect to open the high voltage relays when it detects a fault condition requiring the vehicle to be shut down.

DTC PARAMETERS

This DTC will set anytime the BPM has commanded the auto disconnect to open. The BPM will command the auto disconnect open when:

- Severe undervoltage is detected.
- Severe overvoltage is detected.
- Unintended charging detected.

Failure must be present for 10 seconds.

ACTION TAKEN

The DTC is set, the WAIT telltale is illuminated and propulsion is disabled.

- Vehicle is less than 1 km/h (1 KPH on Scan tool) for 180 seconds.

OR

- Vehicle is in park for 10 seconds.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Module DTCs, BPM 220, 221, 291 and 292

TELLTALE ILLUMINATED

WAIT

DIAGNOSTIC AIDS

The status of the AD state lines is:

A = 0 Volts

B = 5 Volts

C = 0 Volts

The AD pulls the state lines low.

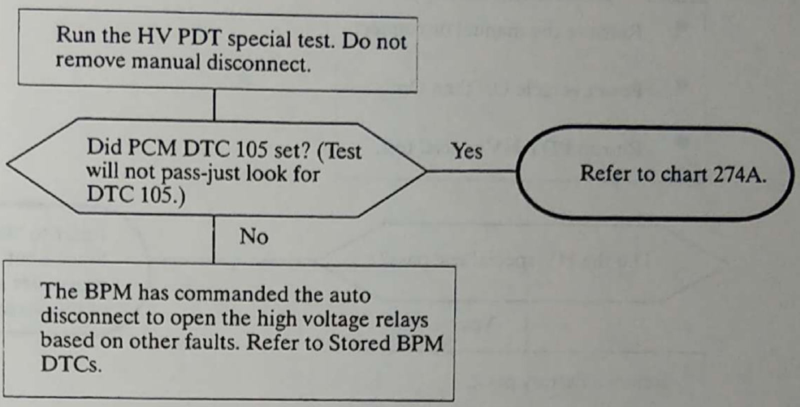
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

CS CamScanner

DTC 274
AUTO DISCONNECT RELAYS COMMANDED OPEN


Run the HV PDT special test. Do not remove manual disconnect.
Did PCM DTC 105 set? (Test will not pass-just look for DTC 105.)
Yes
Refer to chart 274A.
No
The BPM has commanded the auto disconnect to open the high voltage relays based on other faults. Refer to Stored BPM DTCs.

DTC 274A

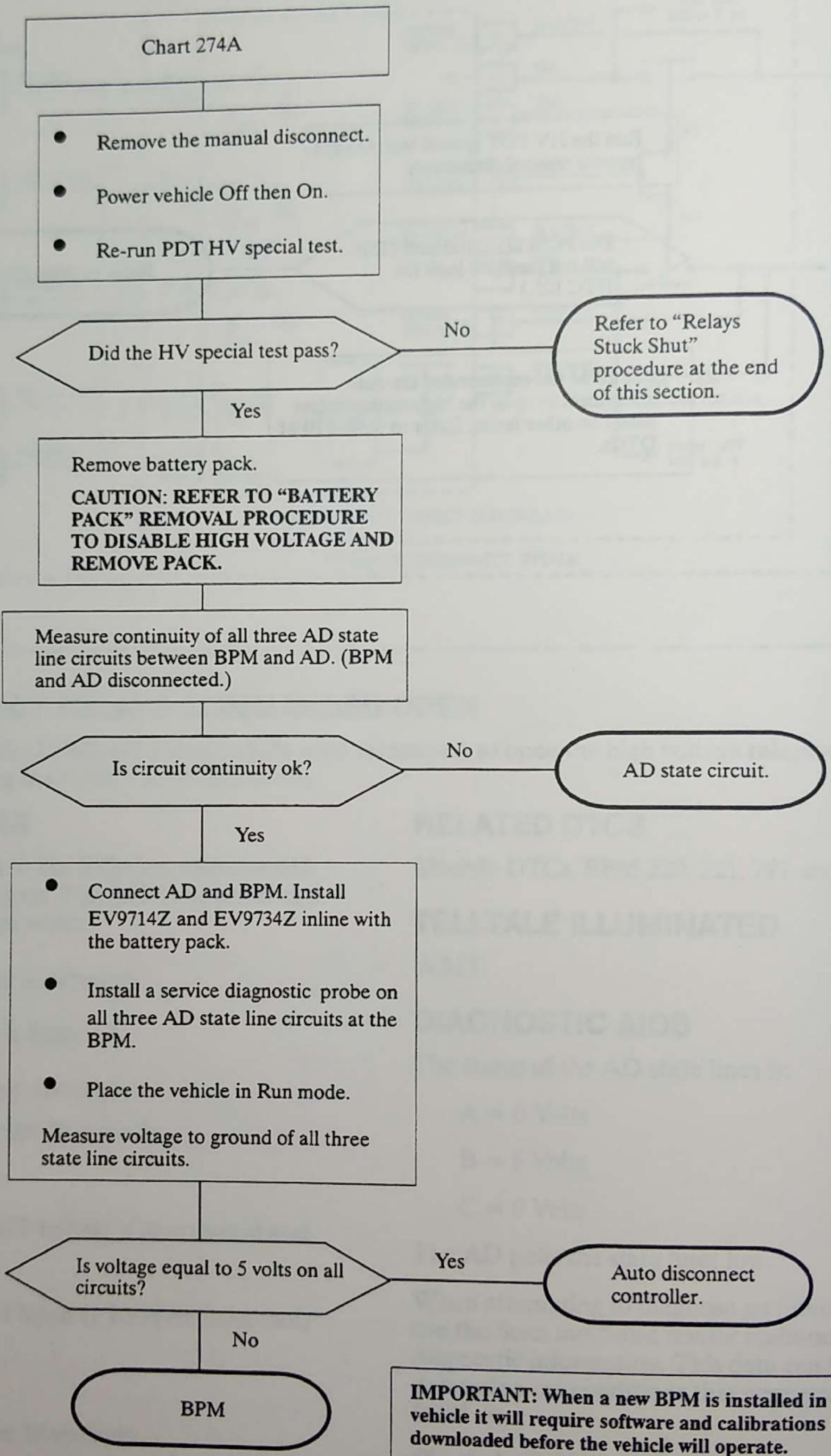
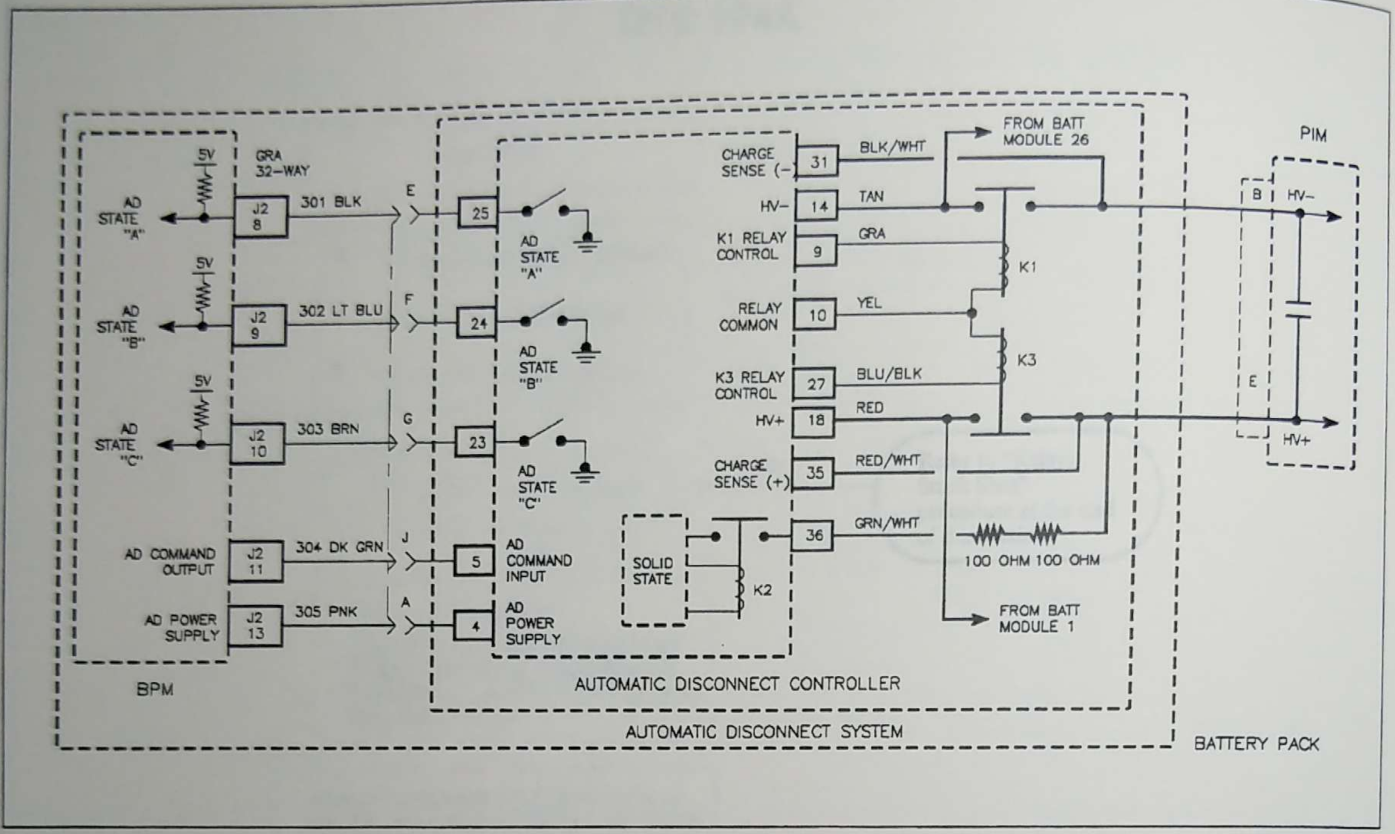


Chart 274A
• Remove the manual disconnect.
• Power vehicle Off then On.
• Re-run PDT HV special test.
Did the HV special test pass?
No
Refer to "Relays Stuck Shut" procedure at the end of this section.
Yes
Remove battery pack.
CAUTION: REFER TO "BATTERY PACK" REMOVAL PROCEDURE TO DISABLE HIGH VOLTAGE AND REMOVE PACK.
Measure continuity of all three AD state line circuits between BPM and AD. (BPM and AD disconnected.)
Is circuit continuity ok?
No
AD state circuit.
Yes
• Connect AD and BPM. Install EV9714Z and EV9734Z inline with the battery pack.
• Install a service diagnostic probe on all three AD state line circuits at the BPM.
• Place the vehicle in Run mode.
Measure voltage to ground of all three state line circuits.
Is voltage equal to 5 volts on all circuits?
Yes
Auto disconnect controller.
No
BPM

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 275 – AUTO DISCONNECT HIGH VOLTAGE INTERLOCK (LOOP) FAULT


5V
GRA
32-WAY
AD STATE "A"
J2 8
301 BLK
E
25
AD STATE "A"
5V
AD STATE "B"
J2 9
302 LT BLU
F
24
AD STATE "B"
5V
AD STATE "C"
J2 10
303 BRN
G
23
AD STATE "C"
AD COMMAND OUTPUT
J2 11
304 DK GRN
J
5
AD COMMAND INPUT
AD POWER SUPPLY
J2 13
305 PNK
A
4
AD POWER SUPPLY
BPM
SOLID STATE
K2
CHARGE SENSE (–)
31
BLK/WHT
FROM BATT MODULE 26
HV–
14
TAN
K1 RELAY CONTROL
9
GRA
K1
RELAY COMMON
10
YEL
K3 RELAY CONTROL
27
BLU/BLK
K3
HV+
18
RED
CHARGE SENSE (+)
35
RED/WHT
36
GRN/WHT
100 OHM 100 OHM
FROM BATT MODULE 1
PIM
B
HV–
E
HV+
AUTOMATIC DISCONNECT CONTROLLER
AUTOMATIC DISCONNECT SYSTEM
BATTERY PACK

PSMELC68201AA

AUTO DISCONNECT HIGH VOLTAGE INTERLOCK (LOOP) FAULT

The interlock loop is a low voltage circuit that parallels the same path as the high voltage circuits. The auto disconnect (AD) applies a 7.9–10.6 voltage to the loop circuit to ensure its continuity. The AD monitors this circuit for a voltage drop to ensure the integrity of all high voltage connections are maintained. The interlock loop is functional between 3.2 and 7.3 volts.

DTC PARAMETERS

This DTC will set anytime an open or a voltage between 0-2.0 volts is detected by the auto disconnect circuit. The BPM will set DTC after 10 seconds with failure present.

ACTION TAKEN

The DTC is set, the WAIT telltale illuminated and propulsion is disabled.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 70

TELLTALE ILLUMINATED

WAIT

DIAGNOSTIC AIDS

- Check all high voltage and interlock loop pin connections.
- Excessive corrosion or loose pin connections can increase the resistance and cause a large enough voltage drop to set this fault.
- The status of the AD state lines is:

  A = 0 Volts
  B = 5 Volts
  C = 5 Volts

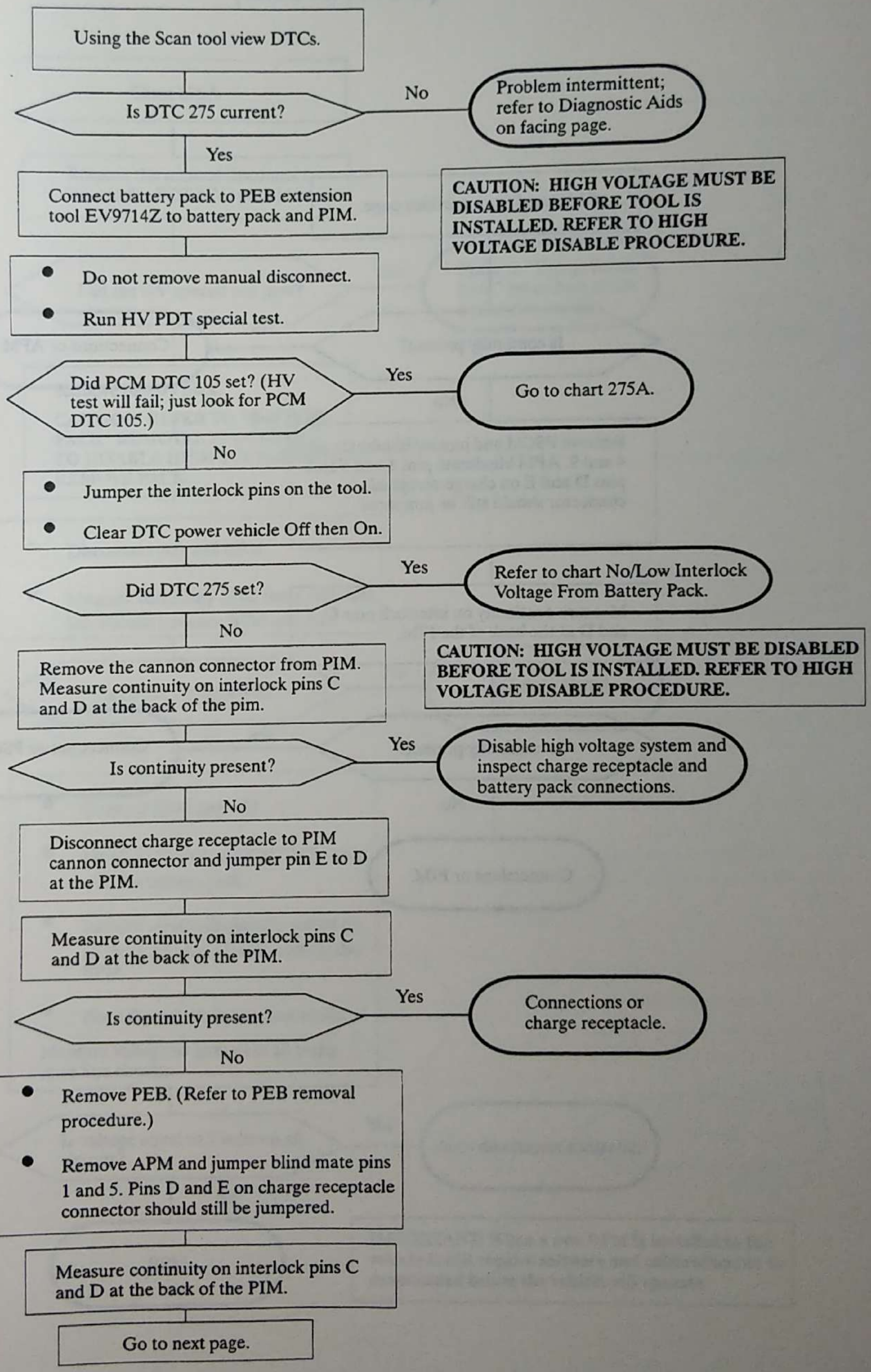
The AD pulls the state lines low.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

DTC 275
AUTO DISCONNECT HIGH VOLTAGE INTERLOCK (LOOP) FAULT


Using the Scan tool view DTCs.
Is DTC 275 current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Connect battery pack to PEB extension tool EV9714Z to battery pack and PIM.
CAUTION: HIGH VOLTAGE MUST BE DISABLED BEFORE TOOL IS INSTALLED. REFER TO HIGH VOLTAGE DISABLE PROCEDURE.
• Do not remove manual disconnect.
• Run HV PDT special test.
Did PCM DTC 105 set? (HV test will fail; just look for PCM DTC 105.)
Yes
Go to chart 275A.
No
• Jumper the interlock pins on the tool.
• Clear DTC power vehicle Off then On.
Did DTC 275 set?
Yes
Refer to chart No/Low Interlock Voltage From Battery Pack.
No
Remove the cannon connector from PIM. Measure continuity on interlock pins C and D at the back of the pim.
CAUTION: HIGH VOLTAGE MUST BE DISABLED BEFORE TOOL IS INSTALLED. REFER TO HIGH VOLTAGE DISABLE PROCEDURE.
Is continuity present?
Yes
Disable high voltage system and inspect charge receptacle and battery pack connections.
No
Disconnect charge receptacle to PIM cannon connector and jumper pin E to D at the PIM.
Measure continuity on interlock pins C and D at the back of the PIM.
Is continuity present?
Yes
Connections or charge receptacle.
No
• Remove PEB. (Refer to PEB removal procedure.)
• Remove APM and jumper blind mate pins 1 and 5. Pins D and E on charge receptacle connector should still be jumpered.
Measure continuity on interlock pins C and D at the back of the PIM.
Go to next page.

DTC 275
AUTO DISCONNECT HIGH VOLTAGE INTERLOCK (LOOP) FAULT – (CONTINUED)

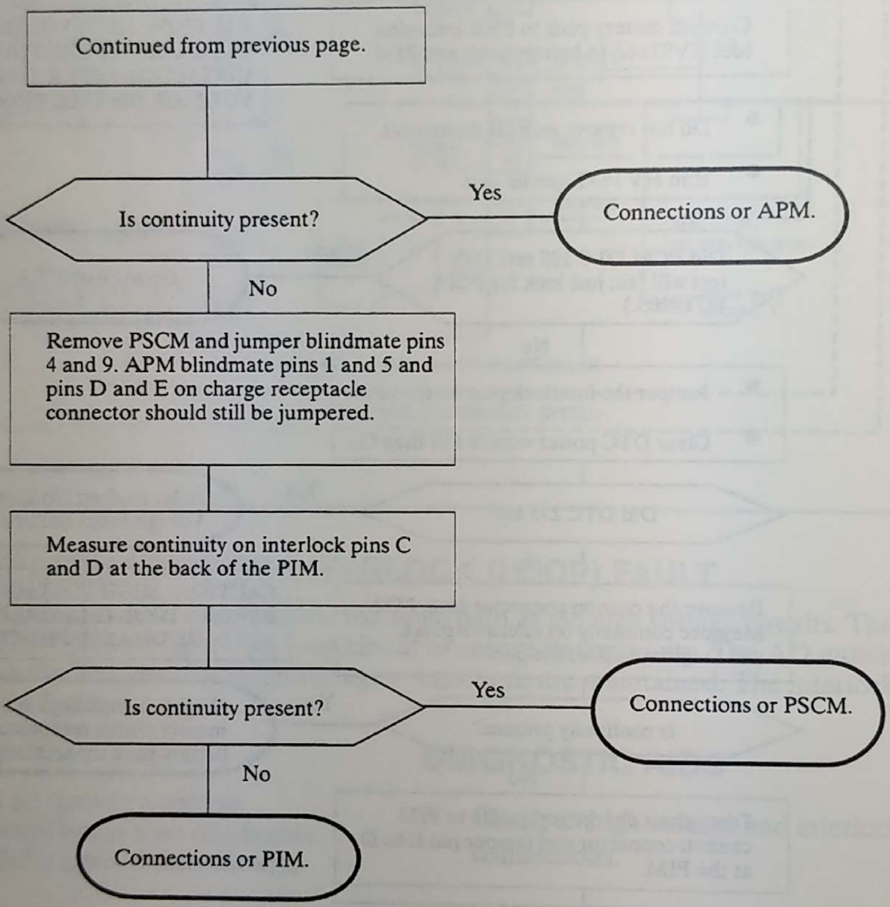

Continued from previous page.
Is continuity present?
Yes
Connections or APM.
No
Remove PSCM and jumper blindmate pins 4 and 9. APM blindmate pins 1 and 5 and pins D and E on charge receptacle connector should still be jumpered.
Measure continuity on interlock pins C and D at the back of the PIM.
Is continuity present?
Yes
Connections or PSCM.
No
Connections or PIM.

CHART 275A

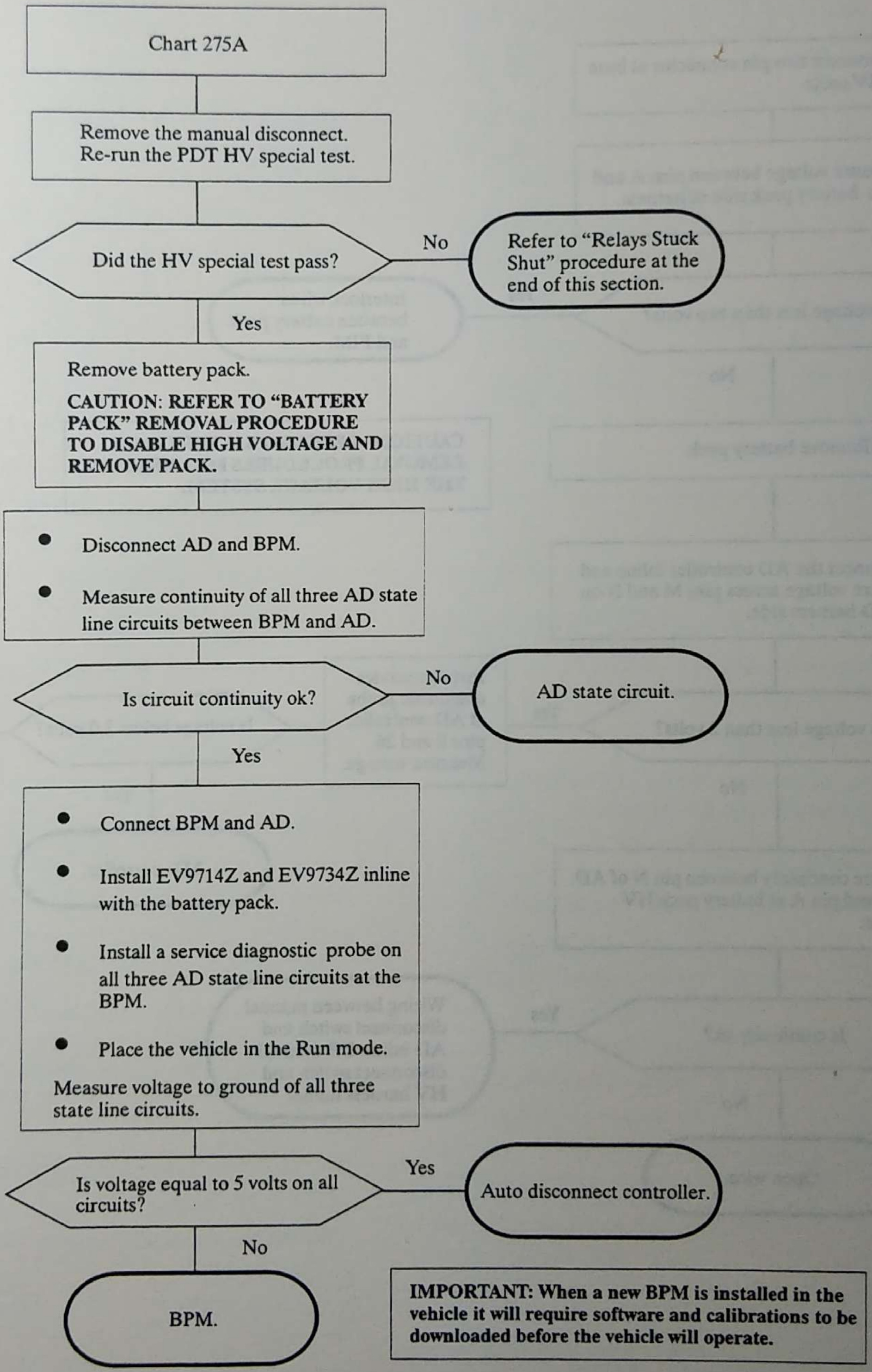


Chart 275A

Remove the manual disconnect.
Re-run the PDT HV special test.

Did the HV special test pass?

No

Refer to “Relays Stuck Shut” procedure at the end of this section.

Yes

Remove battery pack.

CAUTION: REFER TO “BATTERY PACK” REMOVAL PROCEDURE TO DISABLE HIGH VOLTAGE AND REMOVE PACK.

- Disconnect AD and BPM.
- Measure continuity of all three AD state line circuits between BPM and AD.

Is circuit continuity ok?

No

AD state circuit.

Yes

- Connect BPM and AD.
- Install EV9714Z and EV9734Z inline with the battery pack.
- Install a service diagnostic probe on all three AD state line circuits at the BPM.
- Place the vehicle in the Run mode.

Measure voltage to ground of all three state line circuits.

Is voltage equal to 5 volts on all circuits?

Yes

Auto disconnect controller.

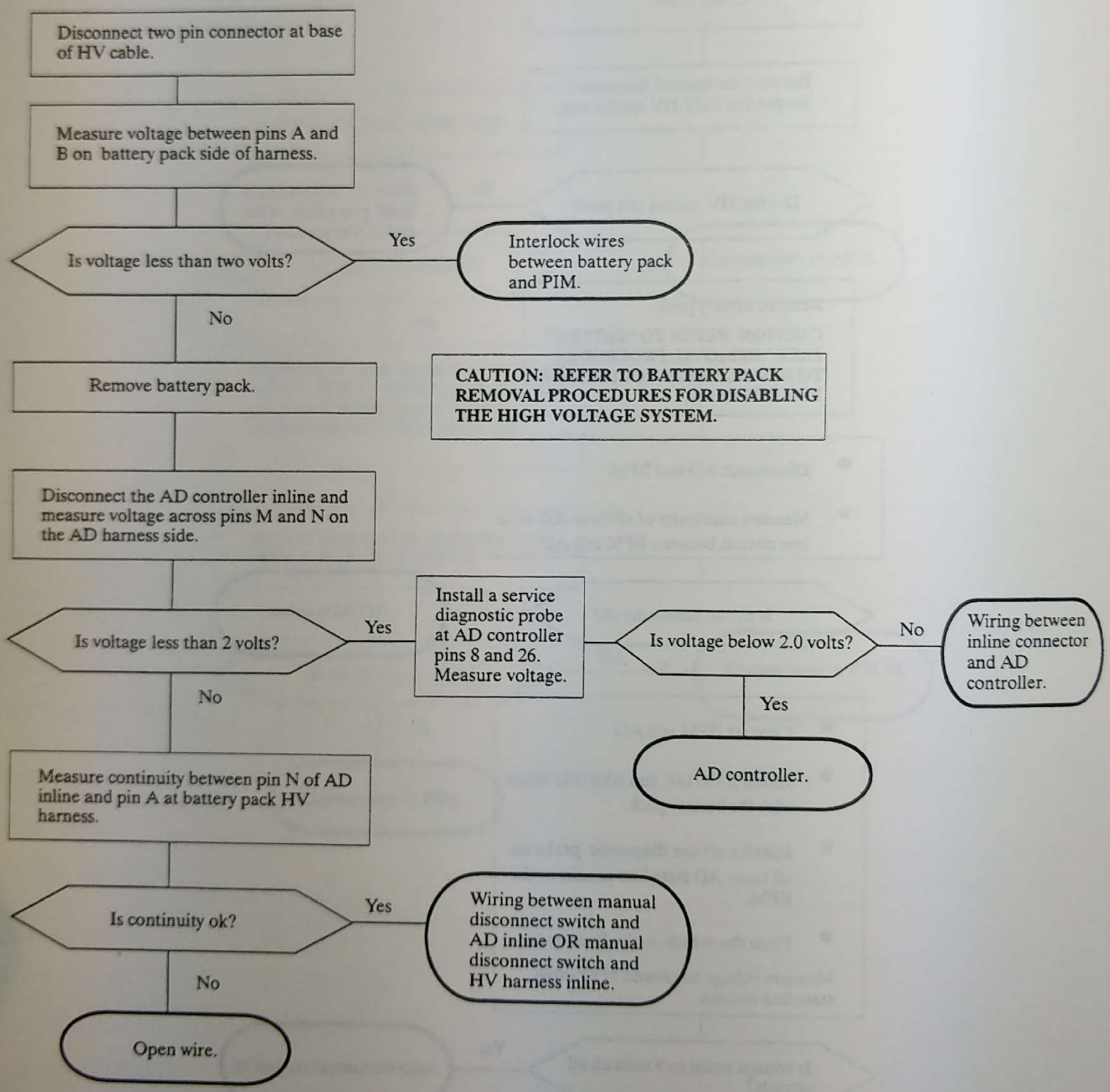
No

BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

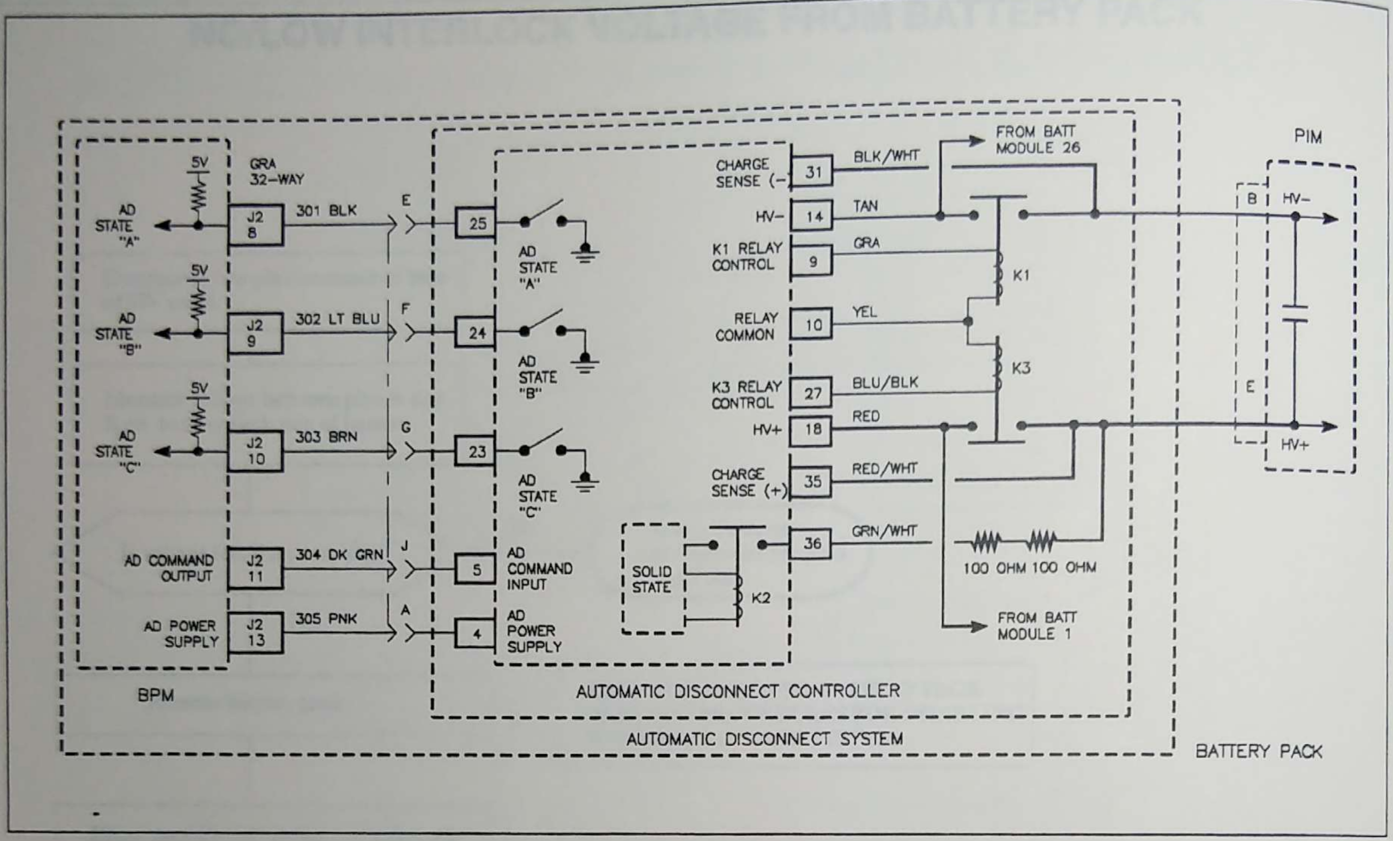
DTC 275

NO/LOW INTERLOCK VOLTAGE FROM BATTERY PACK


Disconnect two pin connector at base of HV cable.
Measure voltage between pins A and B on battery pack side of harness.
Is voltage less than two volts?
Yes
Interlock wires between battery pack and PIM.
No
Remove battery pack.
CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.
Disconnect the AD controller inline and measure voltage across pins M and N on the AD harness side.
Is voltage less than 2 volts?
Yes
Install a service diagnostic probe at AD controller pins 8 and 26. Measure voltage.
Is voltage below 2.0 volts?
No
Wiring between inline connector and AD controller.
Yes
AD controller.
No
Measure continuity between pin N of AD inline and pin A at battery pack HV harness.
Is continuity ok?
Yes
Wiring between manual disconnect switch and AD inline OR manual disconnect switch and HV harness inline.
No
Open wire.

NOTES

DTC 276 – AUTO DISCONNECT STATE PRECHARGE


5V
GRA
32–WAY
AD STATE "A"
J2 8
301 BLK
E
25
AD STATE "A"
5V
AD STATE "B"
J2 9
302 LT BLU
F
24
AD STATE "B"
5V
AD STATE "C"
J2 10
303 BRN
G
23
AD STATE "C"
AD COMMAND OUTPUT
J2 11
304 DK GRN
J
5
AD COMMAND INPUT
AD POWER SUPPLY
J2 13
305 PNK
A
4
AD POWER SUPPLY
SOLID STATE
K2
BPM
CHARGE SENSE (–)
31
BLK/WHT
FROM BATT MODULE 26
HV–
14
TAN
K1 RELAY CONTROL
9
GRA
K1
RELAY COMMON
10
YEL
K3 RELAY CONTROL
27
BLU/BLK
K3
HV+
18
RED
CHARGE SENSE (+)
35
RED/WHT
36
GRN/WHT
100 OHM 100 OHM
FROM BATT MODULE 1
PIM
B
HV–
E
HV+
AUTOMATIC DISCONNECT CONTROLLER
AUTOMATIC DISCONNECT SYSTEM
BATTERY PACK

PSMELC68201AA

AUTO DISCONNECT STATE PRECHARGE

The auto disconnect (AD) is reporting to the battery pack module (BPM) that it is currently going through precharge. This is just a status.

DTC PARAMETERS

This DTC will set anytime the BPM REFERS TO the AD in the precharge state for 10 seconds.

ACTION TAKEN

The DTC is set and WAIT telltale illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

WAIT

DIAGNOSTIC AIDS

The status of the AD state lines is:

A = 0 Volts

B = 5 Volts

C = 5 Volts

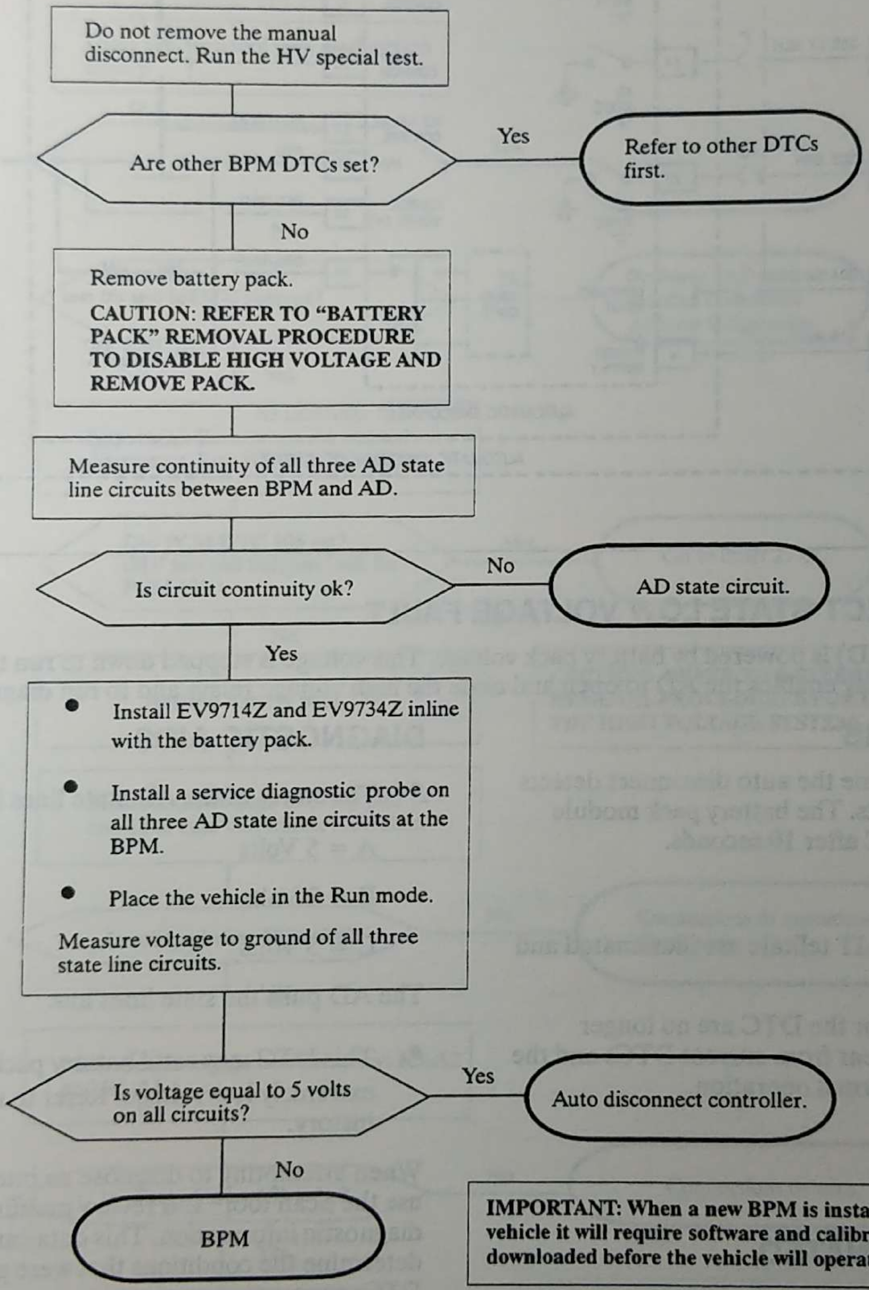
The AD pulls the state lines low.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

AUTO DISCONNECT STATE PRECHARGE
DTC 276



Do not remove the manual disconnect. Run the HV special test.

Are other BPM DTCs set?

Refer to other DTCs first.

Remove battery pack.

CAUTION: REFER TO "BATTERY PACK" REMOVAL PROCEDURE TO DISABLE HIGH VOLTAGE AND REMOVE PACK.

Measure continuity of all three AD state line circuits between BPM and AD.

Is circuit continuity ok?

AD state circuit.

- Install EV9714Z and EV9734Z inline with the battery pack.
- Install a service diagnostic probe on all three AD state line circuits at the BPM.
- Place the vehicle in the Run mode.

Measure voltage to ground of all three state line circuits.

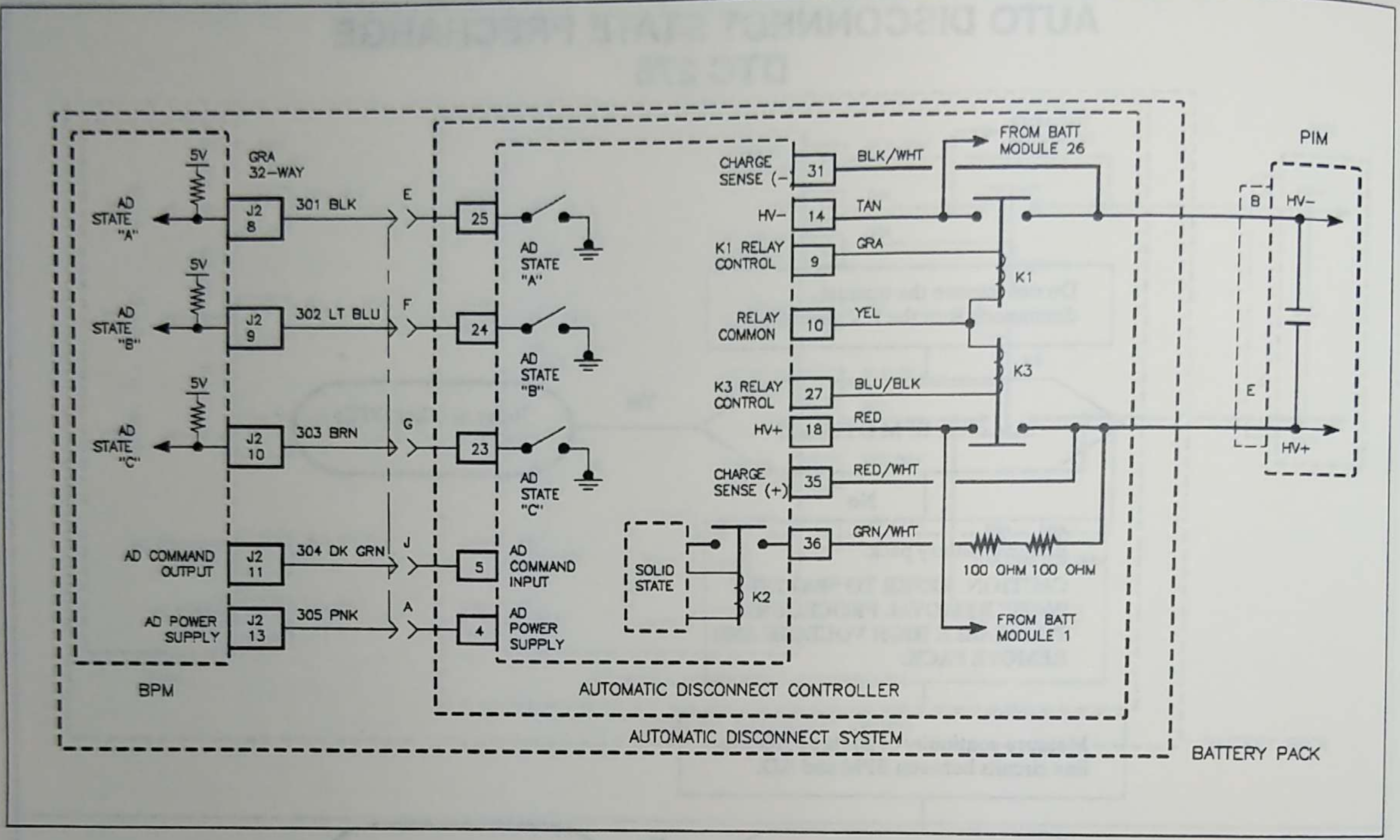
Is voltage equal to 5 volts on all circuits?

Auto disconnect controller.

BPM

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 277 – AUTO DISCONNECT STATE LOW VOLTAGE FAULT


5V
AD STATE "A"
GRA 32–WAY
J2 8
301 BLK
E
25
AD STATE "A"
5V
AD STATE "B"
J2 9
302 LT BLU
F
24
AD STATE "B"
5V
AD STATE "C"
J2 10
303 BRN
G
23
AD STATE "C"
AD COMMAND OUTPUT
J2 11
304 DK GRN
J
5
AD COMMAND INPUT
AD POWER SUPPLY
J2 13
305 PNK
A
4
AD POWER SUPPLY
BPM
CHARGE SENSE (–)
31
BLK/WHT
FROM BATT MODULE 26
HV–
14
TAN
K1 RELAY CONTROL
9
GRA
K1
RELAY COMMON
10
YEL
K3 RELAY CONTROL
27
BLU/BLK
K3
HV+
18
RED
CHARGE SENSE (+)
35
RED/WHT
SOLID STATE
K2
36
GRN/WHT
100 OHM 100 OHM
FROM BATT MODULE 1
PIM
B
HV–
E
HV+
AUTOMATIC DISCONNECT CONTROLLER
AUTOMATIC DISCONNECT SYSTEM
BATTERY PACK

PSMELC68201AA

AUTO DISCONNECT STATE LOW VOLTAGE FAULT

The auto disconnect (AD) is powered by battery pack voltage. This voltage is stepped down to run the AD power supply. This power supply enables the AD to open and close the high voltage relays and to run diagnostics.

DTC PARAMETERS

This DTC will set anytime the auto disconnect detects a voltage below 182 volts. The battery pack module (BPM) will set the DTC after 10 seconds.

ACTION TAKEN

The DTC is set, the WAIT telltale are illuminated and propulsion is disabled.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

WAIT

DIAGNOSTIC AIDS

- The status of the AD state lines is:

  A = 5 Volts

  B = 0 Volts

  C = 5 Volts

The AD pulls the state lines low.

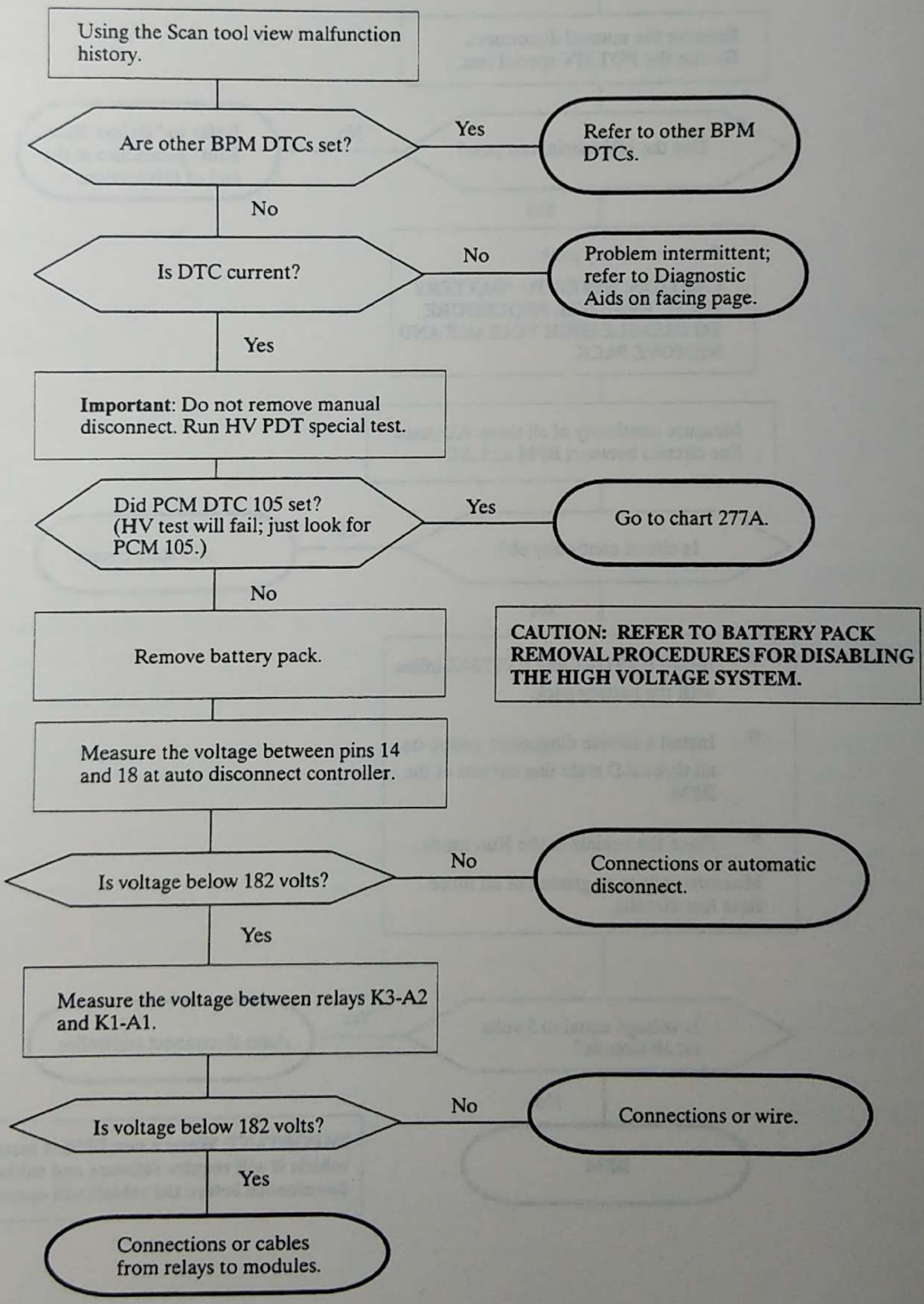
- This DTC may set if battery pack was driven to an extremely low voltage. Refer to malfunction history.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

DTC 277
AUTO DISCONNECT STATE LOW VOLTAGE FAULT


Using the Scan tool view malfunction history.
Are other BPM DTCs set?
Yes
Refer to other BPM DTCs.
No
Is DTC current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Important: Do not remove manual disconnect. Run HV PDT special test.
Did PCM DTC 105 set? (HV test will fail; just look for PCM 105.)
Yes
Go to chart 277A.
No
Remove battery pack.
Measure the voltage between pins 14 and 18 at auto disconnect controller.
Is voltage below 182 volts?
No
Connections or automatic disconnect.
Yes
Measure the voltage between relays K3-A2 and K1-A1.
Is voltage below 182 volts?
No
Connections or wire.
Yes
Connections or cables from relays to modules.

CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.

DTC 277A

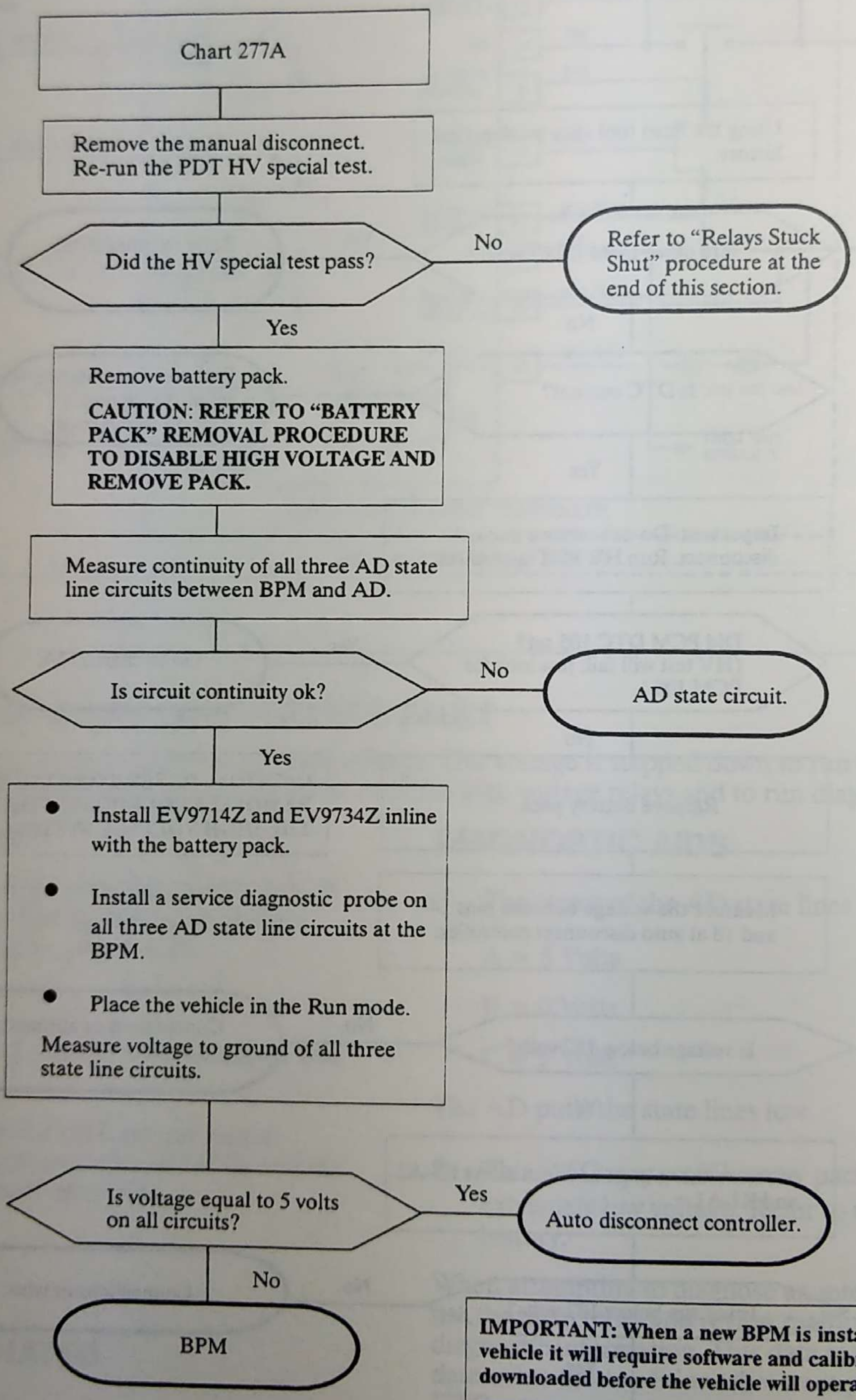
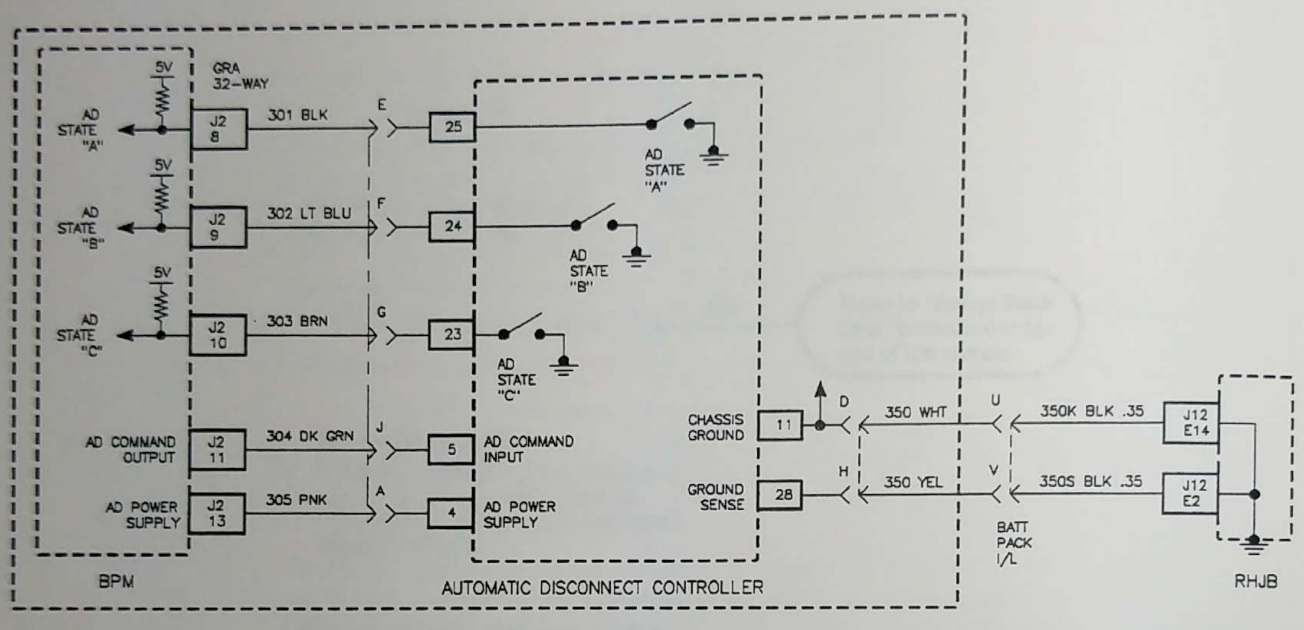


Chart 277A
Remove the manual disconnect. Re-run the PDT HV special test.
Did the HV special test pass?
No
Refer to "Relays Stuck Shut" procedure at the end of this section.
Yes
Remove battery pack.
CAUTION: REFER TO "BATTERY PACK" REMOVAL PROCEDURE TO DISABLE HIGH VOLTAGE AND REMOVE PACK.
Measure continuity of all three AD state line circuits between BPM and AD.
Is circuit continuity ok?
No
AD state circuit.
Yes
• Install EV9714Z and EV9734Z inline with the battery pack.
• Install a service diagnostic probe on all three AD state line circuits at the BPM.
• Place the vehicle in the Run mode.
Measure voltage to ground of all three state line circuits.
Is voltage equal to 5 volts on all circuits?
Yes
Auto disconnect controller.
No
BPM

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 278 – AUTO DISCONNECT GROUND FAULT


5V
GRA
32–WAY
AD
STATE
"A"
J2
8
301 BLK
E
25
AD
STATE
"A"
5V
AD
STATE
"B"
J2
9
302 LT BLU
F
24
AD
STATE
"B"
5V
AD
STATE
"C"
J2
10
303 BRN
G
23
AD
STATE
"C"
AD COMMAND
OUTPUT
J2
11
304 DK GRN
J
5
AD COMMAND
INPUT
AD POWER
SUPPLY
J2
13
305 PNK
A
4
AD POWER
SUPPLY
CHASSIS
GROUND
11
D
350 WHT
U
350K BLK .35
J12
E14
GROUND
SENSE
28
H
350 YEL
V
350S BLK .35
J12
E2
BATT
PACK
I/L
BPM
AUTOMATIC DISCONNECT CONTROLLER
RHJB

PSMELC68209AA

AUTO DISCONNECT GROUND FAULT

The auto disconnect receives two vehicle ground references to use for isolation detection. The AD monitors these ground references for an open.

DTC PARAMETERS

This DTC will set anytime there is a difference of one volt between the two ground references.

ACTION TAKEN

The DTC is set, the WAIT telltale illuminated and propulsion is disabled.

RELATED DTCS

None

TELLTALE ILLUMINATED

WAIT

DIAGNOSTIC AIDS

- The status of the AD state lines is:

  A = 5 Volts

  B = 5 Volts

  C = 0 Volts

  The AD pulls the state lines low.

- This DTC may set if battery pack was driven to an extremely low voltage. Refer to malfunction history.

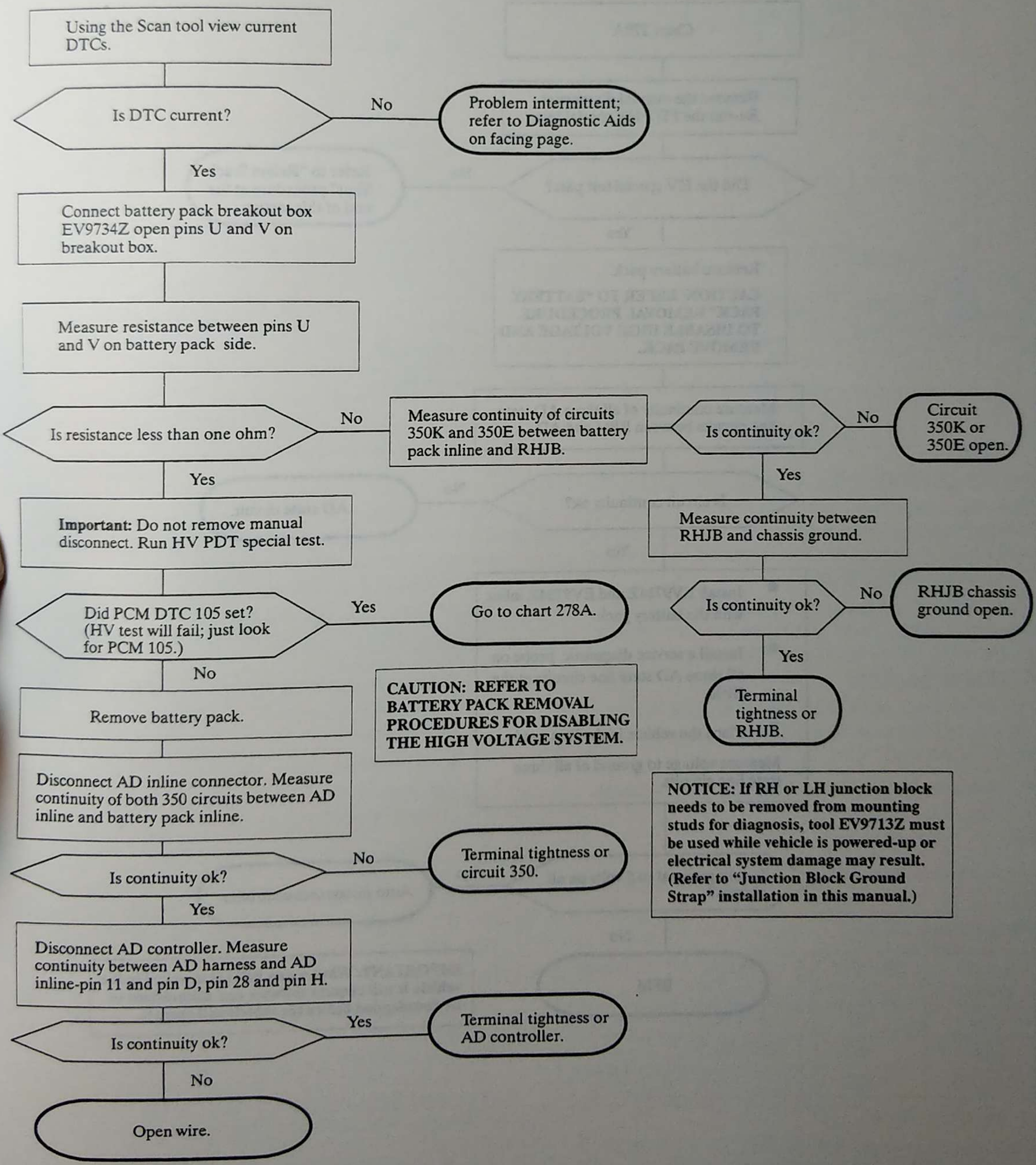
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

Check the tightness of the female terminal grip with a spare male terminal.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

*Select Malf History from the Scan tool BPM menu.

DTC 278
AUTO DISCONNECT GROUND FAULT


Using the Scan tool view current DTCs.
Is DTC current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Connect battery pack breakout box EV9734Z open pins U and V on breakout box.
Measure resistance between pins U and V on battery pack side.
Is resistance less than one ohm?
No
Measure continuity of circuits 350K and 350E between battery pack inline and RHJB.
Is continuity ok?
No
Circuit 350K or 350E open.
Yes
Measure continuity between RHJB and chassis ground.
Is continuity ok?
No
RHJB chassis ground open.
Yes
Terminal tightness or RHJB.
Yes
Important: Do not remove manual disconnect. Run HV PDT special test.
Did PCM DTC 105 set? (HV test will fail; just look for PCM 105.)
Yes
Go to chart 278A.
No
Remove battery pack.
Disconnect AD inline connector. Measure continuity of both 350 circuits between AD inline and battery pack inline.
Is continuity ok?
No
Terminal tightness or circuit 350.
Yes
Disconnect AD controller. Measure continuity between AD harness and AD inline-pin 11 and pin D, pin 28 and pin H.
Is continuity ok?
Yes
Terminal tightness or AD controller.
No
Open wire.

CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.

NOTICE: If RH or LH junction block needs to be removed from mounting studs for diagnosis, tool EV9713Z must be used while vehicle is powered-up or electrical system damage may result. (Refer to "Junction Block Ground Strap" installation in this manual.)

CS CamScanner

DTC 278A

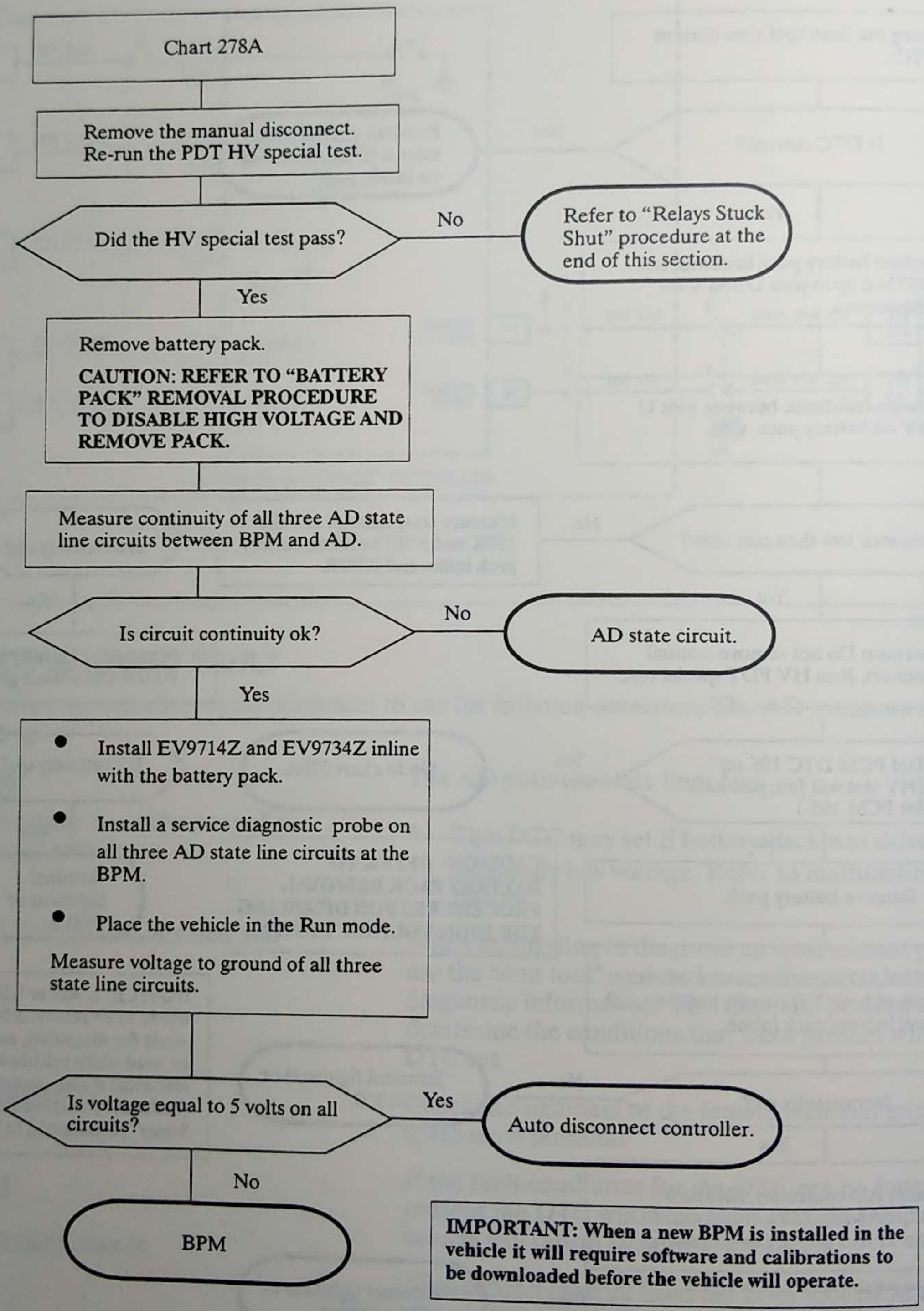
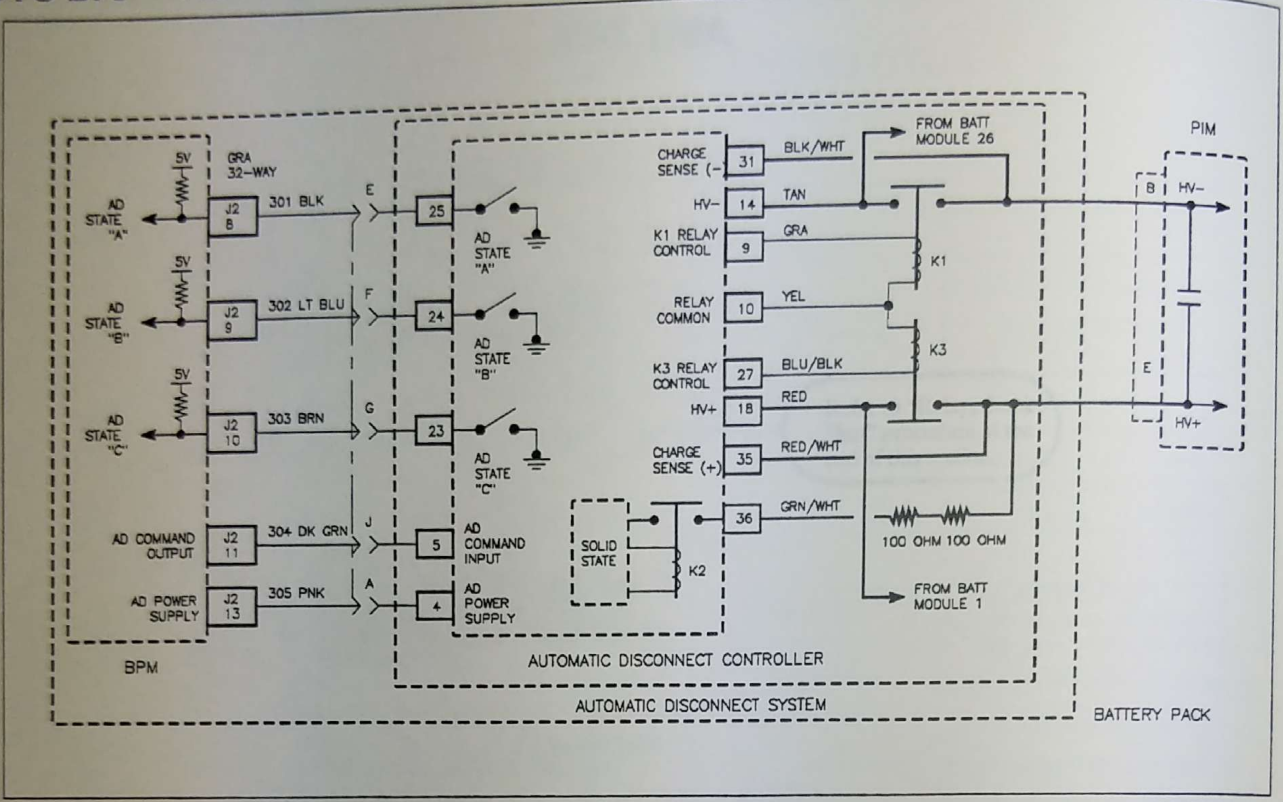


Chart 278A
Remove the manual disconnect. Re-run the PDT HV special test.
Did the HV special test pass?
No
Refer to "Relays Stuck Shut" procedure at the end of this section.
Yes
Remove battery pack.
CAUTION: REFER TO "BATTERY PACK" REMOVAL PROCEDURE TO DISABLE HIGH VOLTAGE AND REMOVE PACK.
Measure continuity of all three AD state line circuits between BPM and AD.
Is circuit continuity ok?
No
AD state circuit.
Yes
• Install EV9714Z and EV9734Z inline with the battery pack.
• Install a service diagnostic probe on all three AD state line circuits at the BPM.
• Place the vehicle in the Run mode.
Measure voltage to ground of all three state line circuits.
Is voltage equal to 5 volts on all circuits?
Yes
Auto disconnect controller.
No
BPM

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 279 – AUTO DISCONNECT (AD) ISOLATION FAULT


5V
GRA
32-WAY
AD STATE "A"
J2 8
301 BLK
E
25
AD STATE "A"
AD STATE "B"
J2 9
302 LT BLU
F
24
AD STATE "B"
AD STATE "C"
J2 10
303 BRN
G
23
AD STATE "C"
AD COMMAND OUTPUT
J2 11
304 DK GRN
J
5
AD COMMAND INPUT
AD POWER SUPPLY
J2 13
305 PNK
A
4
AD POWER SUPPLY
BPM
CHARGE SENSE (-)
31
BLK/WHT
FROM BATT MODULE 26
HV-
14
TAN
K1 RELAY CONTROL
9
GRA
K1
RELAY COMMON
10
YEL
K3
K3 RELAY CONTROL
27
BLU/BLK
HV+
18
RED
CHARGE SENSE (+)
35
RED/WHT
36
GRN/WHT
SOLID STATE
K2
100 OHM 100 OHM
FROM BATT MODULE 1
AUTOMATIC DISCONNECT CONTROLLER
AUTOMATIC DISCONNECT SYSTEM
BATTERY PACK
PIM
B
HV-
E
HV+

PSMELC68201AA

AUTO DISCONNECT (AD) ISOLATION FAULT

The auto disconnect (AD) monitors the positive and negative high voltage leads with reference to chassis ground. The high voltage system should be isolated from chassis ground with at least 600k ohms. If AD detects an imbalance in the high voltage positive or negative bus it will set a failure and cause the relays to be opened.

DTC PARAMETERS

This DTC will set anytime the AD REFERS TO a difference from chassis ground of less than 30% or greater than 70% of pack voltage.

ACTION TAKEN

The DTC is set, the WAIT and SERVICE SOON telltales are illuminated and the relays opened based on the following:

- Vehicle speed is below 1 km/h (1 KPH on Scan tool) for 180 seconds.

OR

- Vehicle is placed in park for 45 seconds.

OR

When current exceeds:

Vehicle Speed*	Current (Amps)	Vehicle Speed *	Current (Amps)
0 (0)	−100	24 (15)	−400
8 (5)	−200	32-80 (20-50)	−440
16 (10)	−300		

*km/h or kph (mph)

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

WAIT and SERVICE SOON

DIAGNOSTIC AIDS

- If the auto disconnect passes pre-charge then an isolation failure occurs. The fault is outside the battery pack.
- If an isolation fault is present and pre-charge fails, the fault is most likely in the AD circuitry or internal to the battery pack.
- The status of the AD state lines is:

A = 5 Volts
B = 5 Volts
C = 5 Volts

The AD pulls the state lines low.

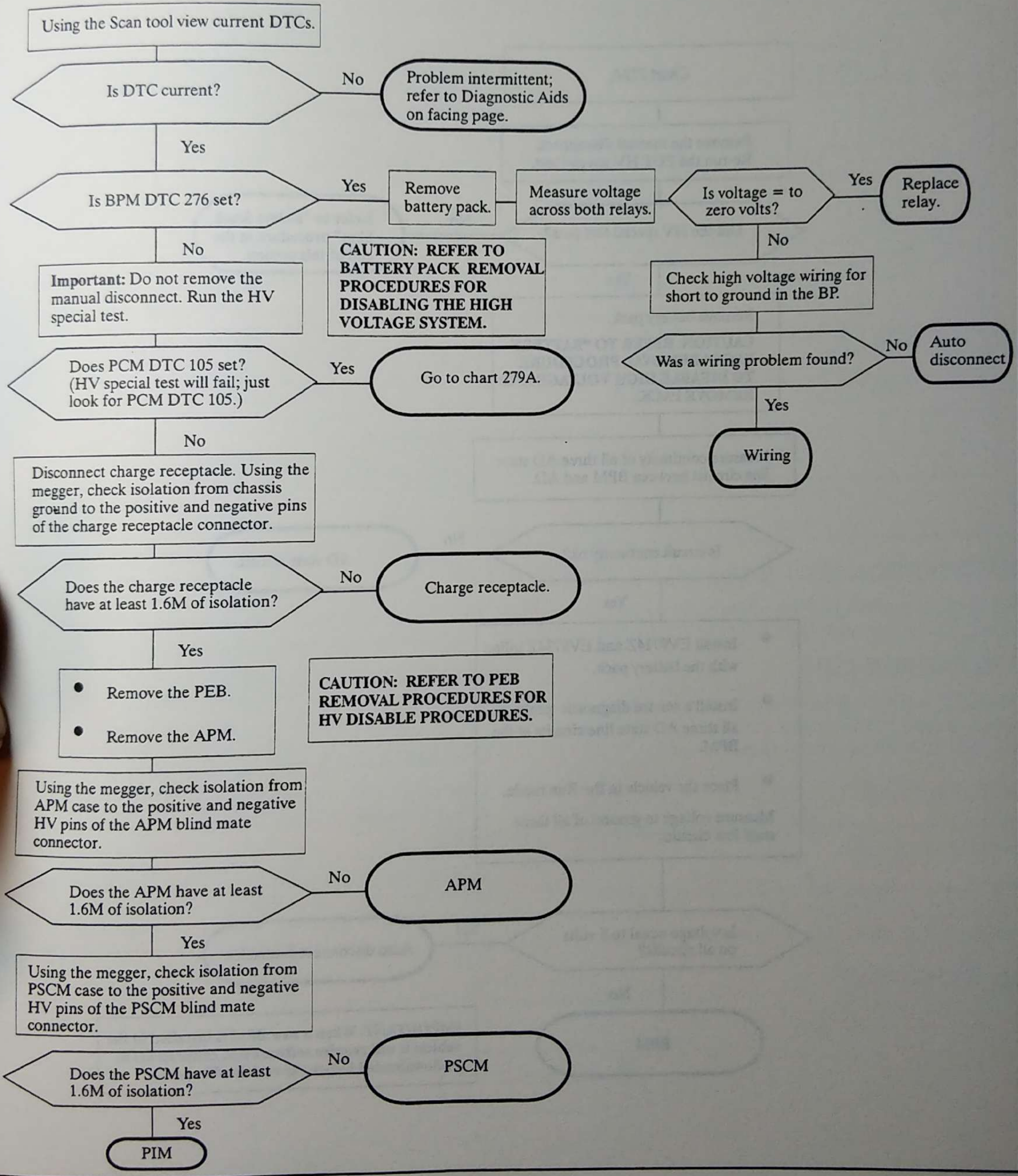
- This DTC may set if battery pack was driven to an extremely low voltage. Refer to malfunction history.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

DTC 279
AUTO DISCONNECT (AD) ISOLATION FAULT



Using the Scan tool view current DTCs.

Is DTC current?

Problem intermittent; refer to Diagnostic Aids on facing page.

Is BPM DTC 276 set?

Remove battery pack.

Measure voltage across both relays.

Is voltage = to zero volts?

Replace relay.

CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.

Check high voltage wiring for short to ground in the BP.

Important: Do not remove the manual disconnect. Run the HV special test.

Was a wiring problem found?

Auto disconnect

Wiring

Does PCM DTC 105 set? (HV special test will fail; just look for PCM DTC 105.)

Go to chart 279A.

Disconnect charge receptacle. Using the megger, check isolation from chassis ground to the positive and negative pins of the charge receptacle connector.

Does the charge receptacle have at least 1.6M of isolation?

Charge receptacle.

- Remove the PEB.
- Remove the APM.

CAUTION: REFER TO PEB REMOVAL PROCEDURES FOR HV DISABLE PROCEDURES.

Using the megger, check isolation from APM case to the positive and negative HV pins of the APM blind mate connector.

Does the APM have at least 1.6M of isolation?

APM

Using the megger, check isolation from PSCM case to the positive and negative HV pins of the PSCM blind mate connector.

Does the PSCM have at least 1.6M of isolation?

PSCM

PIM

CS CamScanner

DTC 279A

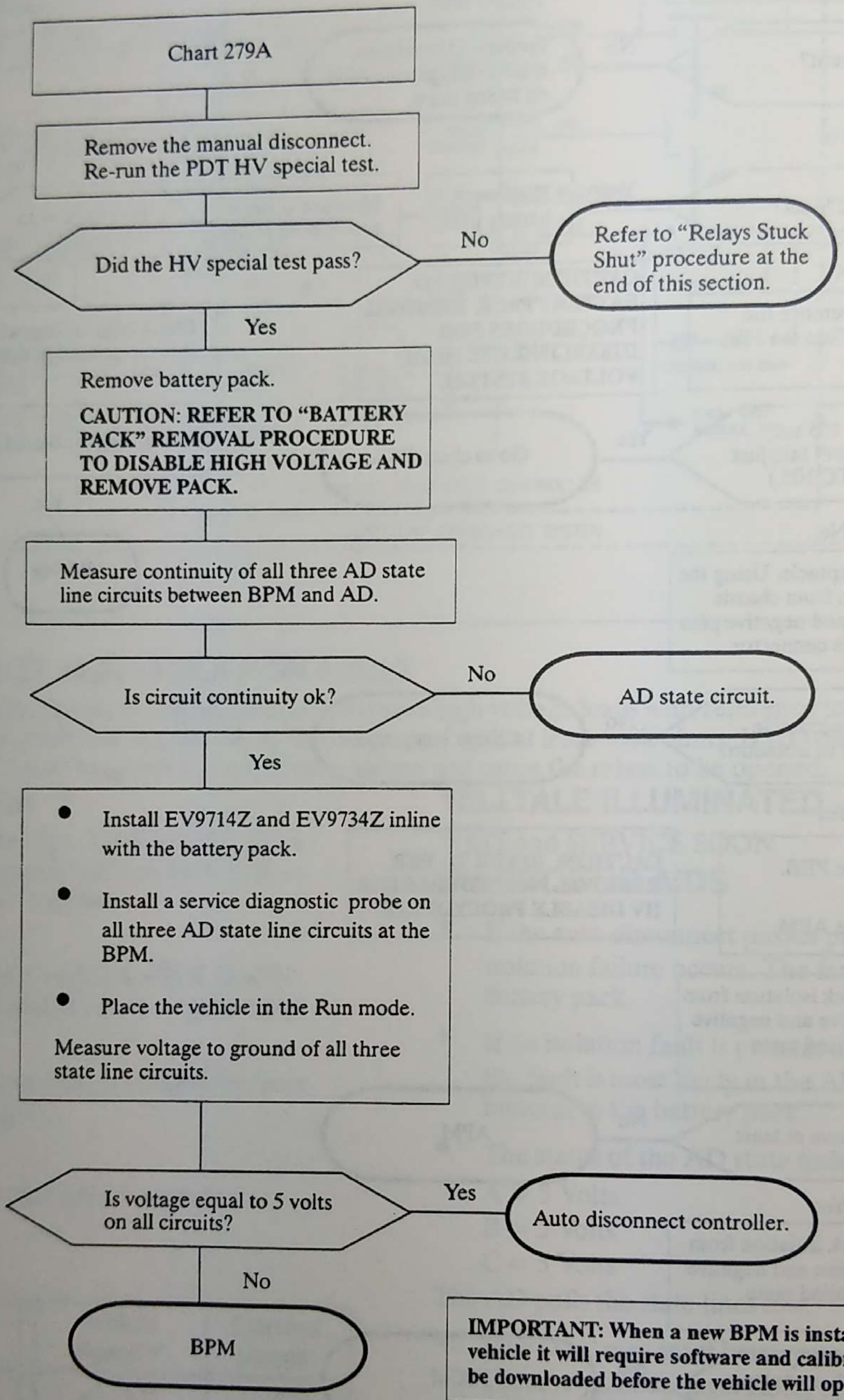
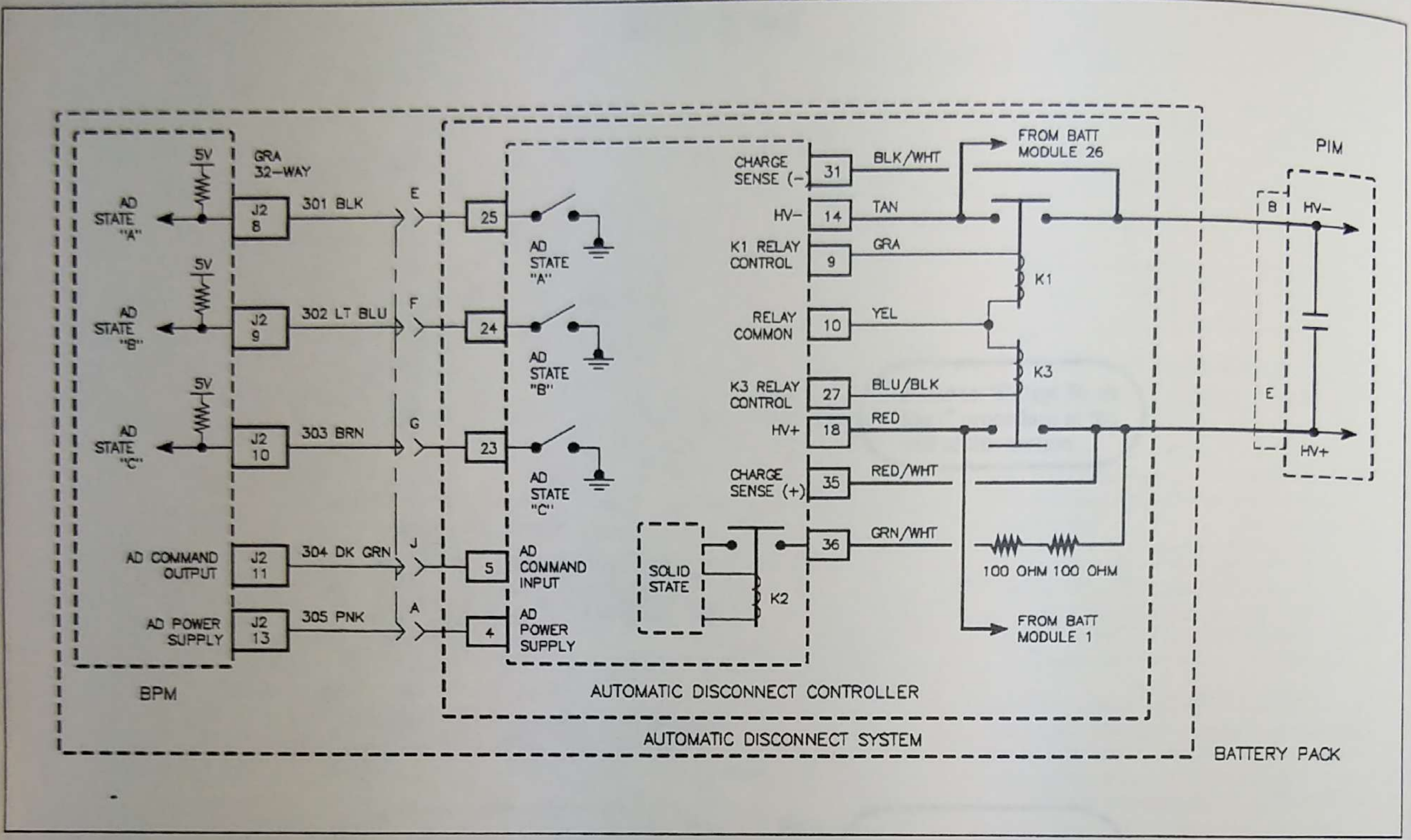


Chart 279A
Remove the manual disconnect. Re-run the PDT HV special test.
Did the HV special test pass?
No
Refer to "Relays Stuck Shut" procedure at the end of this section.
Yes
Remove battery pack.
CAUTION: REFER TO "BATTERY PACK" REMOVAL PROCEDURE TO DISABLE HIGH VOLTAGE AND REMOVE PACK.
Measure continuity of all three AD state line circuits between BPM and AD.
Is circuit continuity ok?
No
AD state circuit.
Yes
Install EV9714Z and EV9734Z inline with the battery pack.
Install a service diagnostic probe on all three AD state line circuits at the BPM.
Place the vehicle in the Run mode.
Measure voltage to ground of all three state line circuits.
Is voltage equal to 5 volts on all circuits?
Yes
Auto disconnect controller.
No
BPM

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTES

DTC 280 – AUTO DISCONNECT (AD) POWER SUPPLY FAULT


5V
GRA
32–WAY
AD
STATE
"A"
J2
8
301 BLK
E
25
AD
STATE
"A"
5V
AD
STATE
"B"
J2
9
302 LT BLU
F
24
AD
STATE
"B"
5V
AD
STATE
"C"
J2
10
303 BRN
G
23
AD
STATE
"C"
AD COMMAND
OUTPUT
J2
11
304 DK GRN
J
5
AD
COMMAND
INPUT
AD POWER
SUPPLY
J2
13
305 PNK
A
4
AD
POWER
SUPPLY
SOLID
STATE
K2
BPM
CHARGE
SENSE (–)
31
BLK/WHT
FROM BATT
MODULE 26
HV–
14
TAN
K1 RELAY
CONTROL
9
GRA
K1
RELAY
COMMON
10
YEL
K3 RELAY
CONTROL
27
BLU/BLK
K3
HV+
18
RED
CHARGE
SENSE (+)
35
RED/WHT
36
GRN/WHT
100 OHM 100 OHM
FROM BATT
MODULE 1
PIM
B
HV–
E
HV+
AUTOMATIC DISCONNECT CONTROLLER
AUTOMATIC DISCONNECT SYSTEM
BATTERY PACK

PSMELC68201AA

AUTO DISCONNECT (AD) POWER SUPPLY FAULT

The auto disconnect (AD) is powered by battery pack voltage. This voltage is stepped down to run the AD power supply. This power supply enables the AD to open and close the high voltage relays and to run diagnostics.

DTC PARAMETERS

This DTC will set anytime the auto disconnect power supply as read by the battery pack module (BPM) is less than 9.5 volts or greater than 15.5 volts.

ACTION TAKEN

The DTC is set, the WAIT telltale illuminated and propulsion is disabled.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

WAIT

DIAGNOSTIC AIDS

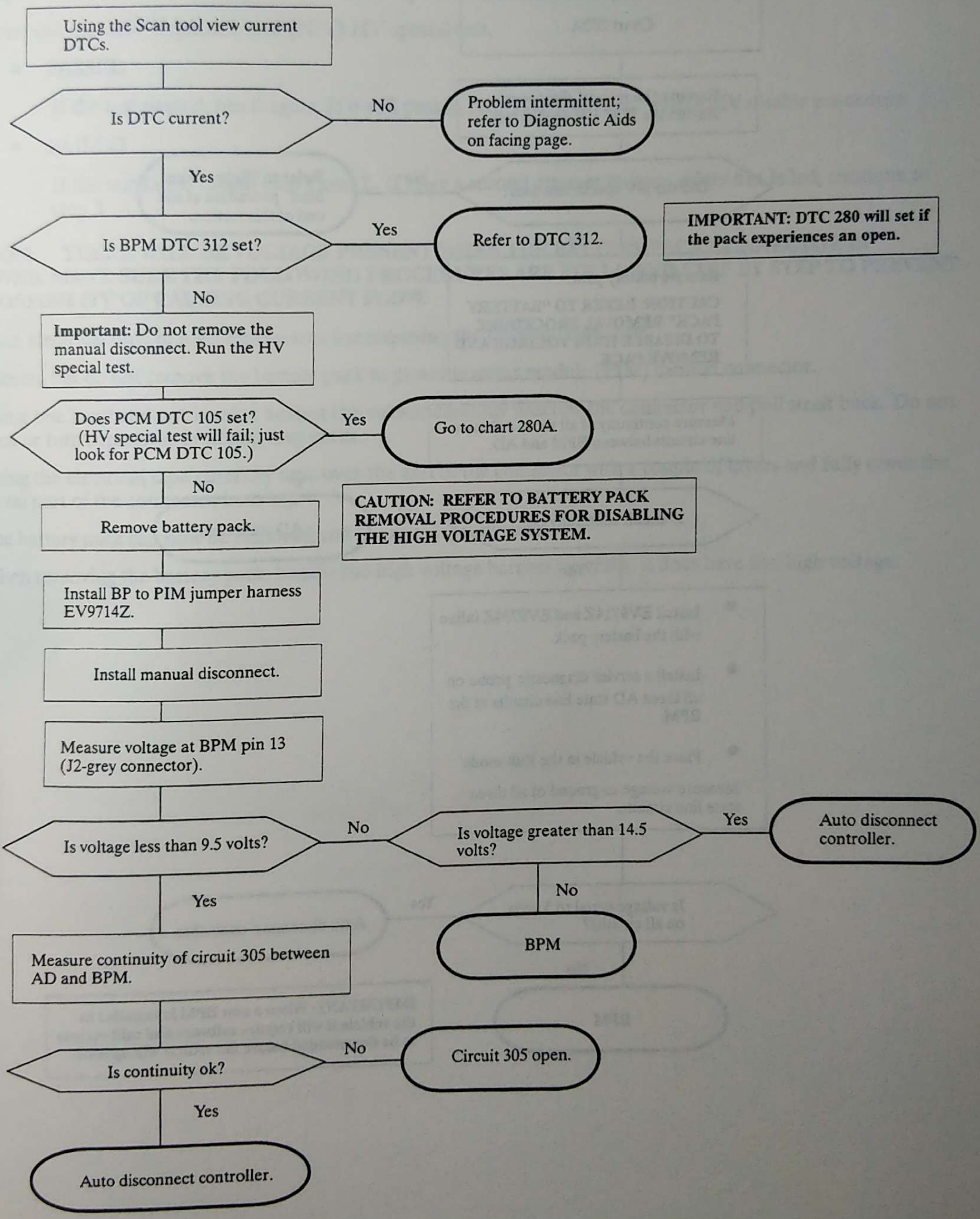
If the manual disconnect is pulled this DTC may set. This is a normal condition and does not indicate a failure.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

DTC 280
AUTO DISCONNECT (AD) POWER SUPPLY FAULT


Using the Scan tool view current DTCs.
Is DTC current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Is BPM DTC 312 set?
Yes
Refer to DTC 312.
IMPORTANT: DTC 280 will set if the pack experiences an open.
No
Important: Do not remove the manual disconnect. Run the HV special test.
Does PCM DTC 105 set? (HV special test will fail; just look for PCM DTC 105.)
Yes
Go to chart 280A.
No
Remove battery pack.
CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.
Install BP to PIM jumper harness EV9714Z.
Install manual disconnect.
Measure voltage at BPM pin 13 (J2-grey connector).
Is voltage less than 9.5 volts?
No
Is voltage greater than 14.5 volts?
Yes
Auto disconnect controller.
No
BPM
Yes
Measure continuity of circuit 305 between AD and BPM.
Is continuity ok?
No
Circuit 305 open.
Yes
Auto disconnect controller.

CS CamScanner

DTC 280A

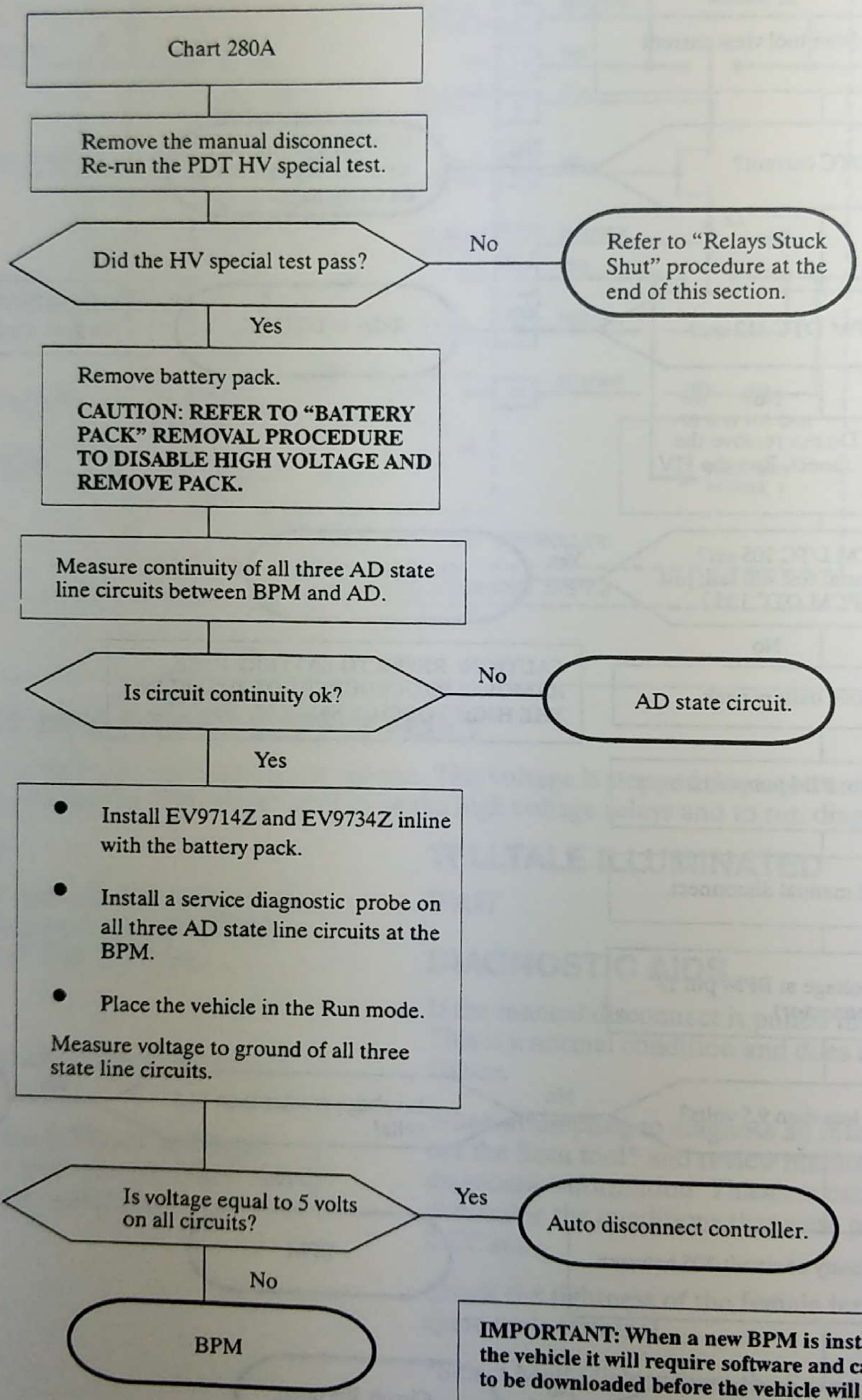


Chart 280A
Remove the manual disconnect. Re-run the PDT HV special test.
Did the HV special test pass?
No
Refer to "Relays Stuck Shut" procedure at the end of this section.
Yes
Remove battery pack.
CAUTION: REFER TO "BATTERY PACK" REMOVAL PROCEDURE TO DISABLE HIGH VOLTAGE AND REMOVE PACK.
Measure continuity of all three AD state line circuits between BPM and AD.
Is circuit continuity ok?
No
AD state circuit.
Yes
• Install EV9714Z and EV9734Z inline with the battery pack.
• Install a service diagnostic probe on all three AD state line circuits at the BPM.
• Place the vehicle in the Run mode.
Measure voltage to ground of all three state line circuits.
Is voltage equal to 5 volts on all circuits?
Yes
Auto disconnect controller.
No
BPM

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

RELAY STUCK SHUT PROCEDURE

IMPORTANT: Before using this procedure make sure you have completed trouble tree "Failed High Voltage (HV) Special Test/High Voltage Present With Relays Commanded Open."

1. Install the manual disconnect knob and power the vehicle On and then remove the manual disconnect. If the relays are stuck shut, an attempt to cycle the relays may cause them to open.
2. Rerun the portable diagnostic tool (PDT) HV special test.
   - PASSED

     If the test passed, run it again. If it still passes, relays have opened. Finish HV disable procedure
   - FAILED

     If the test failed repeat step 1 and 2. If after a second attempt to open relays has failed, continue to step 3.

CAUTION: THERE WILL BE VOLTAGE PRESENT WHEN THE BATTERY PACK CONNECTOR IS REMOVED. MAKE SURE THE FOLLOWING PROCEDURES ARE FOLLOWED STEP BY STEP TO PREVENT THE POSSIBILITY OF CAUSING CURRENT FLOW.

3. Place electrical tape in a accessible area for removing the cannon connector.
4. Loosen, but do not remove the battery pack to power inverter module (PIM) cannon connector.
5. Using one hand and not leaning against the vehicle carefully unscrew the connector and pull strait back. Do not cock or turn connector or arcing may occur.
6. Using the electrical tape carefully tape over the end of the connector with a couple of layers and fully cover the metal part of the connector housing.
7. The battery pack can now be removed and the relay(s) replaced.
8. When removing the battery pack, handle the high voltage harness carefully, it does have live high voltage.

NOTES

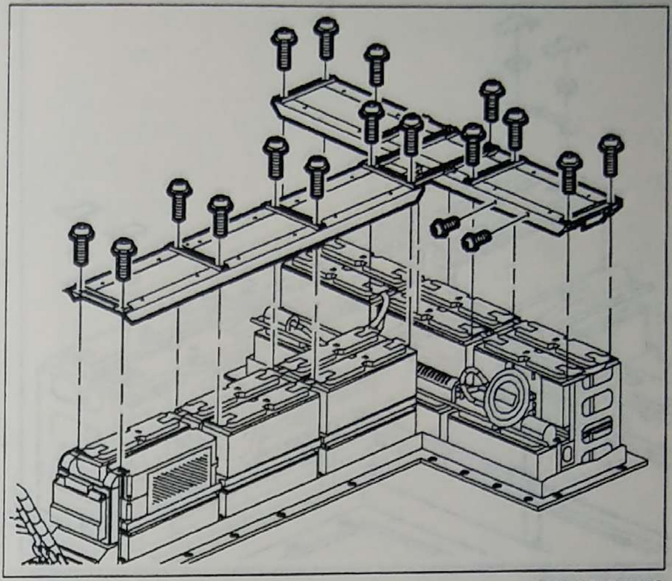
AUTO DISCONNECT (AD) CONTROLLER

REMOVAL

1. Remove the battery pack from the vehicle. (Refer to "Battery Pack" removal in this manual.)

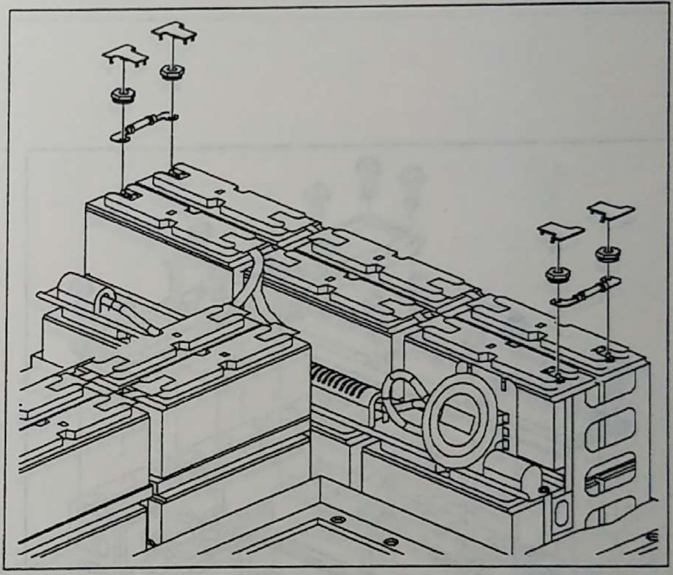
CAUTION: WITH THE BATTERY PACK OUT OF THE VEHICLE YOU ARE EXPOSED TO HIGH VOLTAGE. NEVER LEAN ON THE BATTERY PACK OR TOUCH THE BATTERY BACK WITH BOTH HANDS. FOLLOW ALL PROCEDURES STEP BY STEP.

2. Remove the top covers on the battery pack.



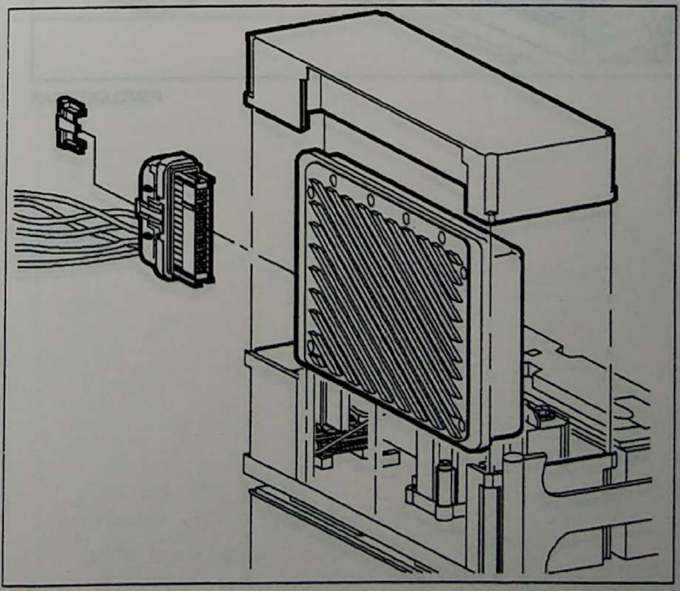
PSMELC67066AB

3. Remove the battery interconnect cables connecting battery terminals at battery module #19 – #20 and #22 – #23. This further breaks down the voltage potential of the battery pack.



PSMELC67073AB

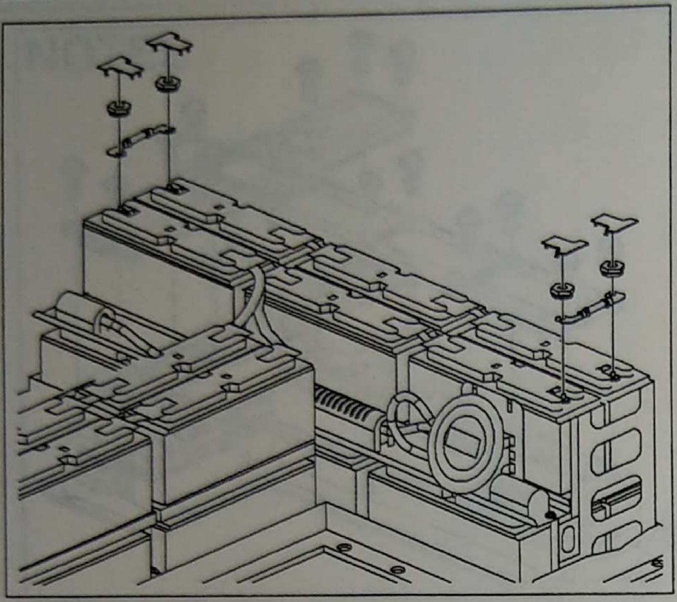
4. Remove the top cover to the auto disconnect (AD) system located in the front, top, left corner of the battery pack (opposite battery module #16).
5. Carefully slide the AD controller straight-up and out of the lower housing.
6. Remove CPA and disconnect the and remove the AD controller.



PSMELC67070AC

INSTALLATION

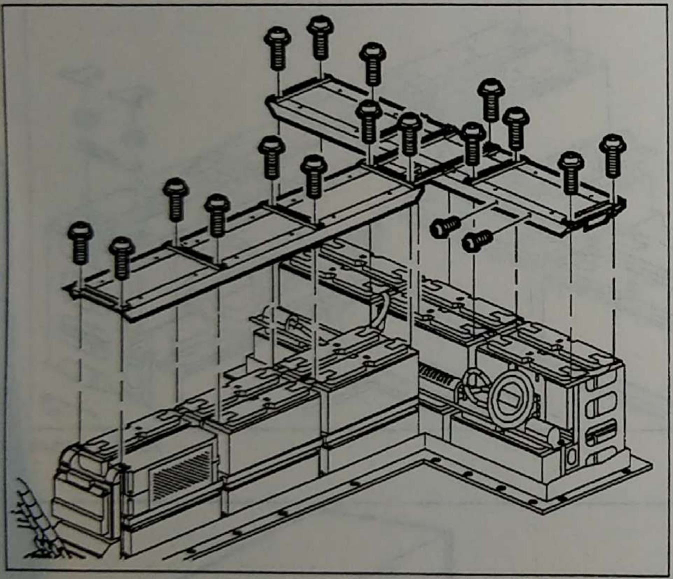
1. Connect the connector to the AD controller and Install CPA.
2. Carefully slide the AD controller into the slots of the lower AD system housing.
3. Install the AD system top cover. Make sure wiring is not pinched.


PSMELC67073AB

4. Install the battery interconnect cables connecting battery terminals at battery modules #19 – #20 and #22 – #23.

Torque: **10 N•m (89 in-lbs)**

5. Visually inspect the pack for pinched/broken vent tubes, wiring etc.


PSMELC67066AB

CAUTION: MAKE SURE WHEN INSTALLING THE TOP COVERS THAT THE VENT HARNESS DOES NOT GET PINCHED. PINCHING THE VENT HARNESS MAY CAUSE THE VENT SYSTEM TO FUNCTION INCORRECTLY.

6. Install the battery pack top covers.

Torque: **10 N•m (89 in-lbs)**
(3 N•m [27 in-lbs] pack top to manual disconnect)

7. Install the battery pack. (Refer to “Battery Pack” installation procedure in this manual.)

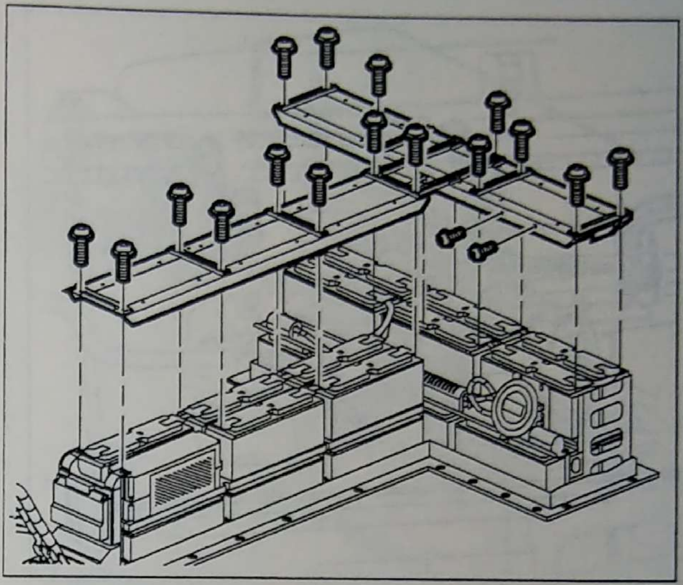
HIGH VOLTAGE RELAYS

REMOVAL

1. Remove the battery pack from the vehicle. (Refer to "Battery Pack" removal in this manual.)

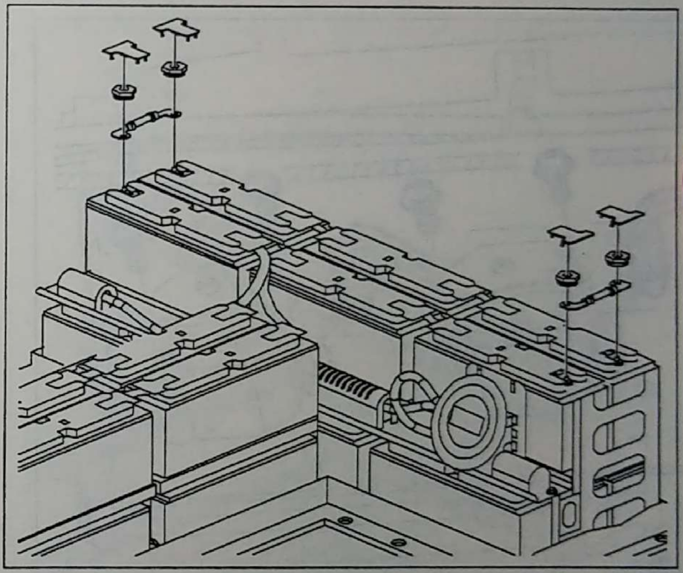
CAUTION: WITH THE BATTERY PACK OUT OF THE VEHICLE YOU ARE EXPOSED TO HIGH VOLTAGE. NEVER LEAN ON THE BATTERY PACK OR TOUCH THE BATTERY BACK WITH BOTH HANDS. FOLLOW ALL PROCEDURES STEP BY STEP.

2. Remove the top covers on the battery pack.



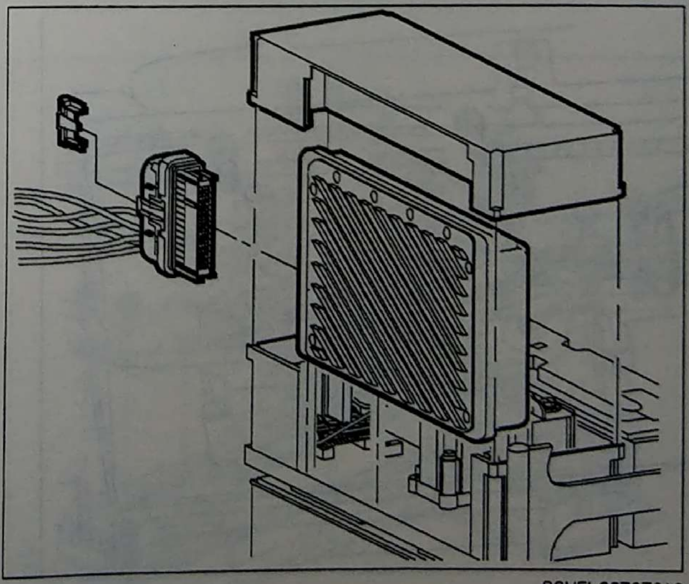
PSMELC67066AB

3. Remove the battery interconnect cables connecting battery terminals at battery module #19 – #20 and #22 – #23. This further breaks down the voltage potential of the battery pack.

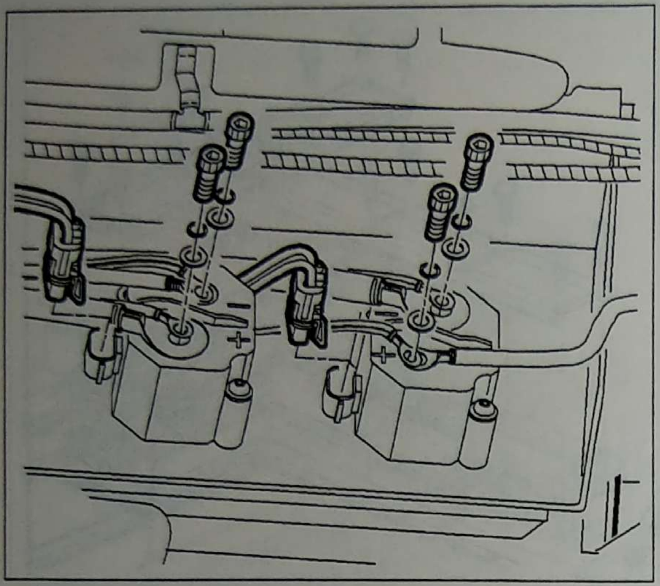


PSMELC67073AB

4. Remove the top cover to the auto disconnect (AD) system located in the front, top, left corner of the battery pack.
5. Carefully slide the AD controller straight-up and out of the lower housing.
6. Disconnect and remove the AD controller.



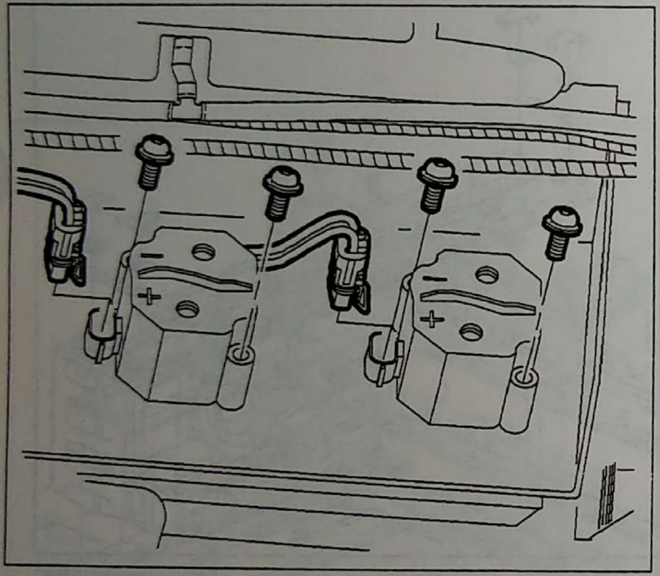
PSMELC67070AC



PSMELC68024AB

7. Carefully remove the high voltage wires from only one high voltage relay and tape. Take note wire locations.

NOTICE: If replacing both high voltage relays replace them one at a time to prevent any chance of incorrect wiring of the high voltage relays.



PSMELC67061AA

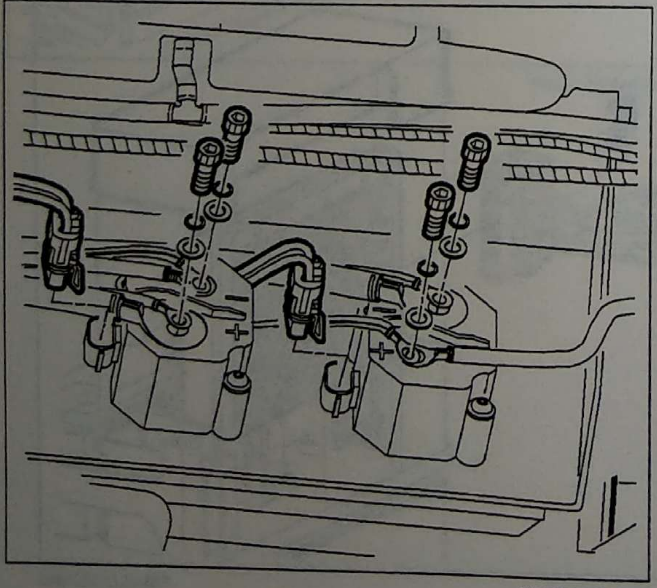
8. Remove the bolts holding the high voltage relay to the battery pack.
9. Remove the two-way connector from the side of the relay.
10. Remove the high voltage relay.

INSTALLATION

1. Install the high voltage relay and tighten the bolts.

Torque: **3 N•m (27 in-lbs)**

2. Install two-way connector in the side of the high voltage relay.



PSMELC68024AB

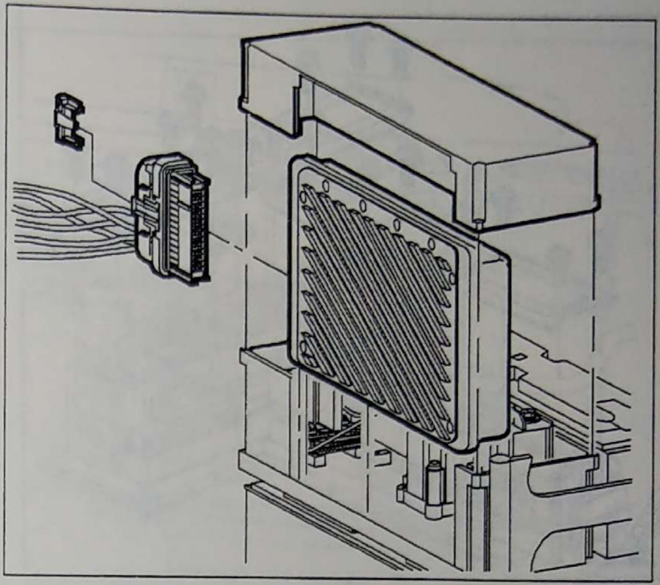
3. Install the high voltage wiring on the high voltage relay.

Torque: **9 N•m (80 in-lbs)**

4. Install the connector and connector–positive assurance (CPA) to the AD controller.

5. Carefully slide the AD controller into the slots of the lower AD system housing.

6. Install the AD system top cover. Make sure wiring is not pinched.

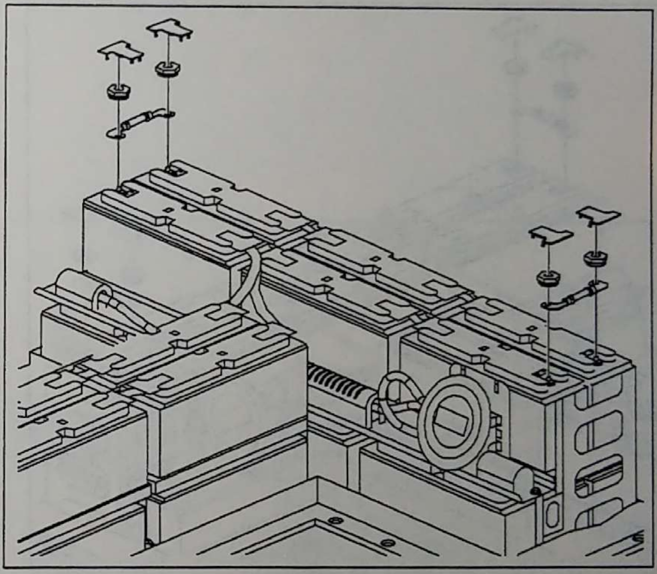


PSMELC67070AC

7. Install the battery interconnect cables connecting battery terminals at battery modules #19 – #20 and #22 – #23.

Torque: **10 N•m (89 in-lbs)**

8. Visually inspect the pack for pinched/broken vent tubes, wiring etc.



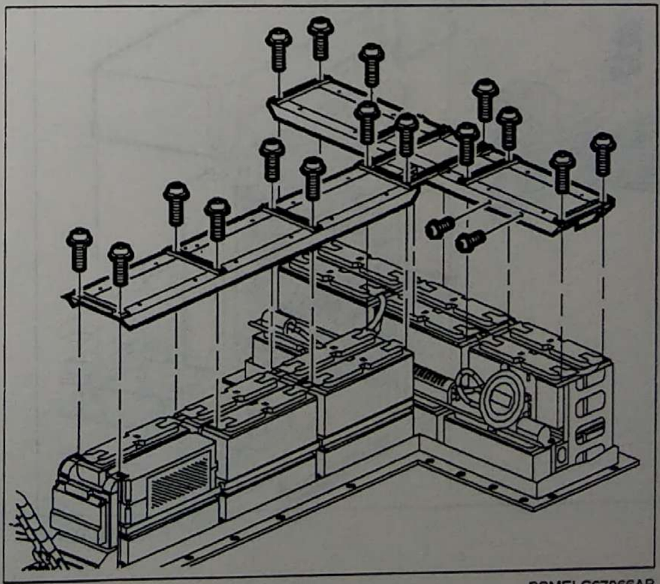
PSMELC67073AB

CAUTION: MAKE SURE WHEN INSTALLING THE TOP COVERS THAT THE VENT HARNESS DOES NOT GET PINCHED. PINCHING THE VENT HARNESS MAY CAUSE THE VENT SYSTEM TO FUNCTION INCORRECTLY.

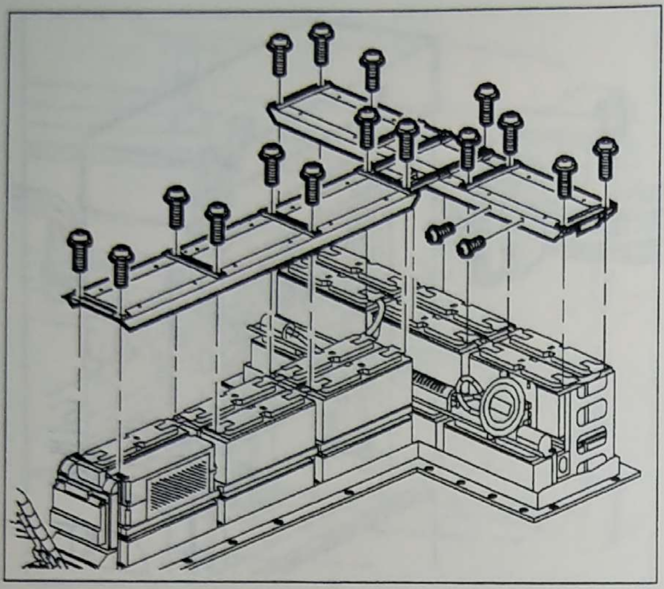
9. Install the battery pack top covers.

Torque: **10 N•m (89 in-lbs)**
(3 N•m [27 in-lbs] pack top to manual disconnect)

10. Install the battery pack. (Refer to "Battery Pack" installation procedure in this manual.)



PSMELC67066AB



PSMELC67066AB

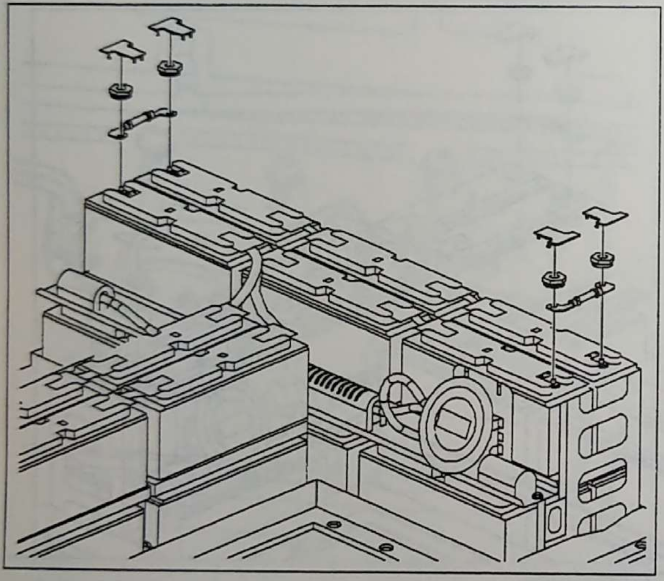
AUTO DISCONNECT HARNESS

REMOVAL

1. Remove the battery pack from the vehicle. (Refer to "Battery Pack" removal in this manual.)

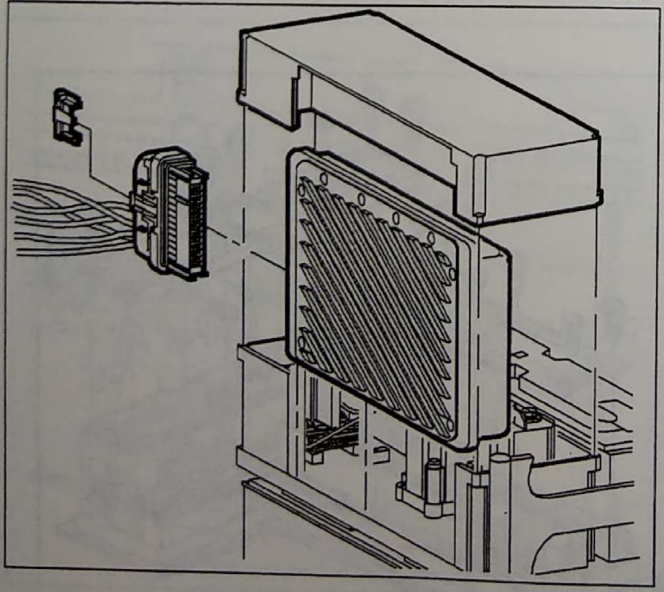
CAUTION: WITH THE BATTERY PACK OUT OF THE VEHICLE YOU ARE EXPOSED TO HIGH VOLTAGE. NEVER LEAN ON THE BATTERY PACK OR TOUCH THE BATTERY BACK WITH BOTH HANDS. FOLLOW ALL PROCEDURES STEP BY STEP.

2. Remove the top covers on the battery pack.



PSMELC67073AB

3. Remove the battery interconnect cables connecting battery terminals at battery module #19 – #20 and #22 – #23. This further breaks down the voltage potential of the battery pack.



PSMELC67070AC

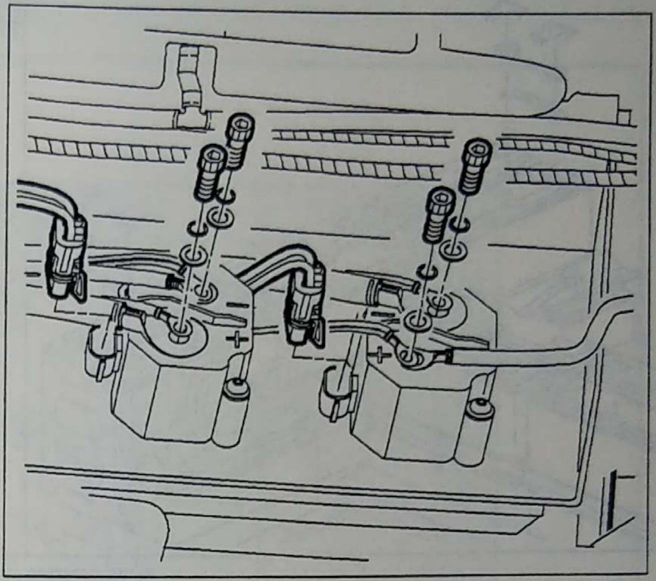
4. Remove the top cover to the auto disconnect (AD) system located in the front, top, left corner of the battery pack (opposite module 16).
5. Carefully slide the AD controller straighten-up and out of the lower housing.
6. Remove connector positive assurance (CPA) and disconnect the AD connector and remove the AD controller.

CS CamScanner

7. Remove allen screws from high voltage relays.

NOTICE: **Make reference to the proper position of high voltage wire and cables.**

8. Remove two 2-wire connectors from the high voltage relays.
9. Remove the bolts holding the two high watt resistors to the AD case.
10. Disconnect the barrel connector.
11. Remove the AD harness.



PSMELC68024AA

INSTALLATION

1. Install the AD harness and high watt resistors to the battery pack AD case.

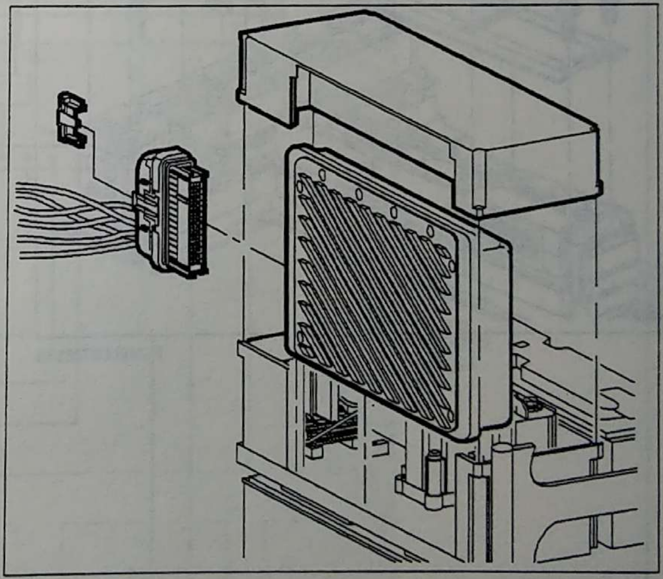
Torque: 1 N•m (8.85 in-lbs)

2. Install both two-wire connectors to their respective high voltage relays.
3. Install high voltage cables and wires to high voltage relays.

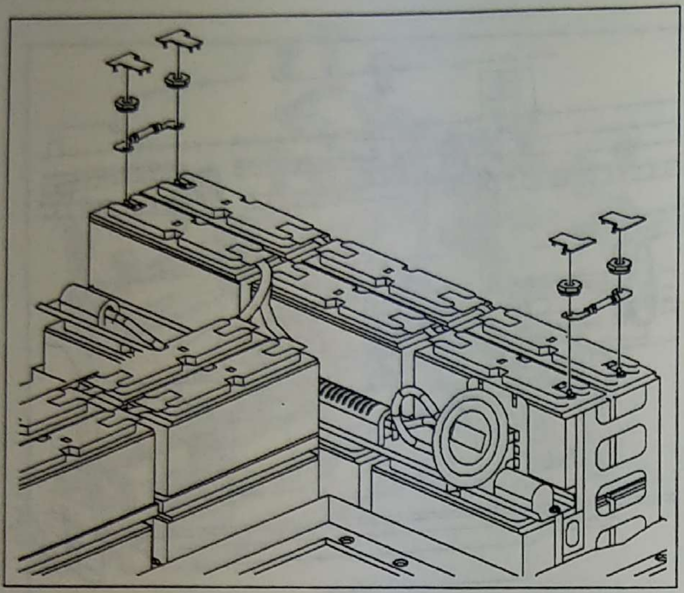
Torque: 9 N•m (80 in-lbs)

IMPORTANT: Install HV cables under the sense wires.

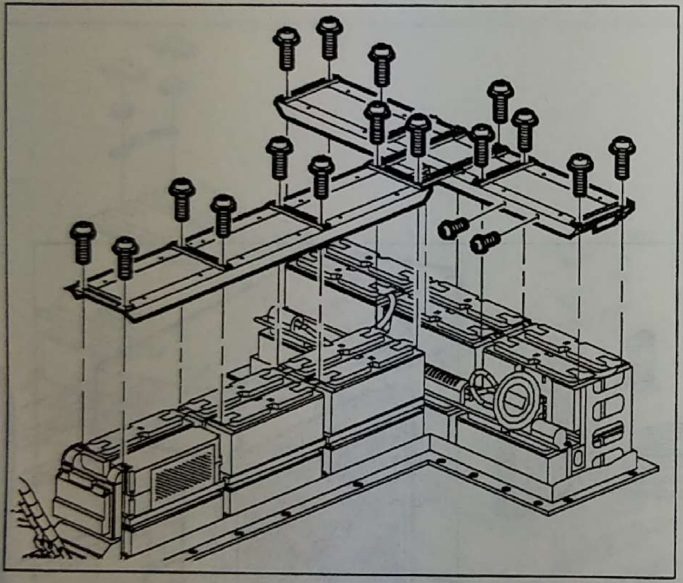
4. Connect the connector to the AD controller and install CPA.
5. Carefully slide the AD controller into the slots of the lower AD system housing.
6. Install the AD system top cover. Make sure wiring is not pinched.



PSMELC67070AC



PSMELC67073AB



PSMELC67066AB

7. Install the battery interconnect cables connecting battery terminals at battery modules #19 – #20 and #22 – #23.

8. Visually inspect the pack for pinched/broken vent tubes, wiring etc.

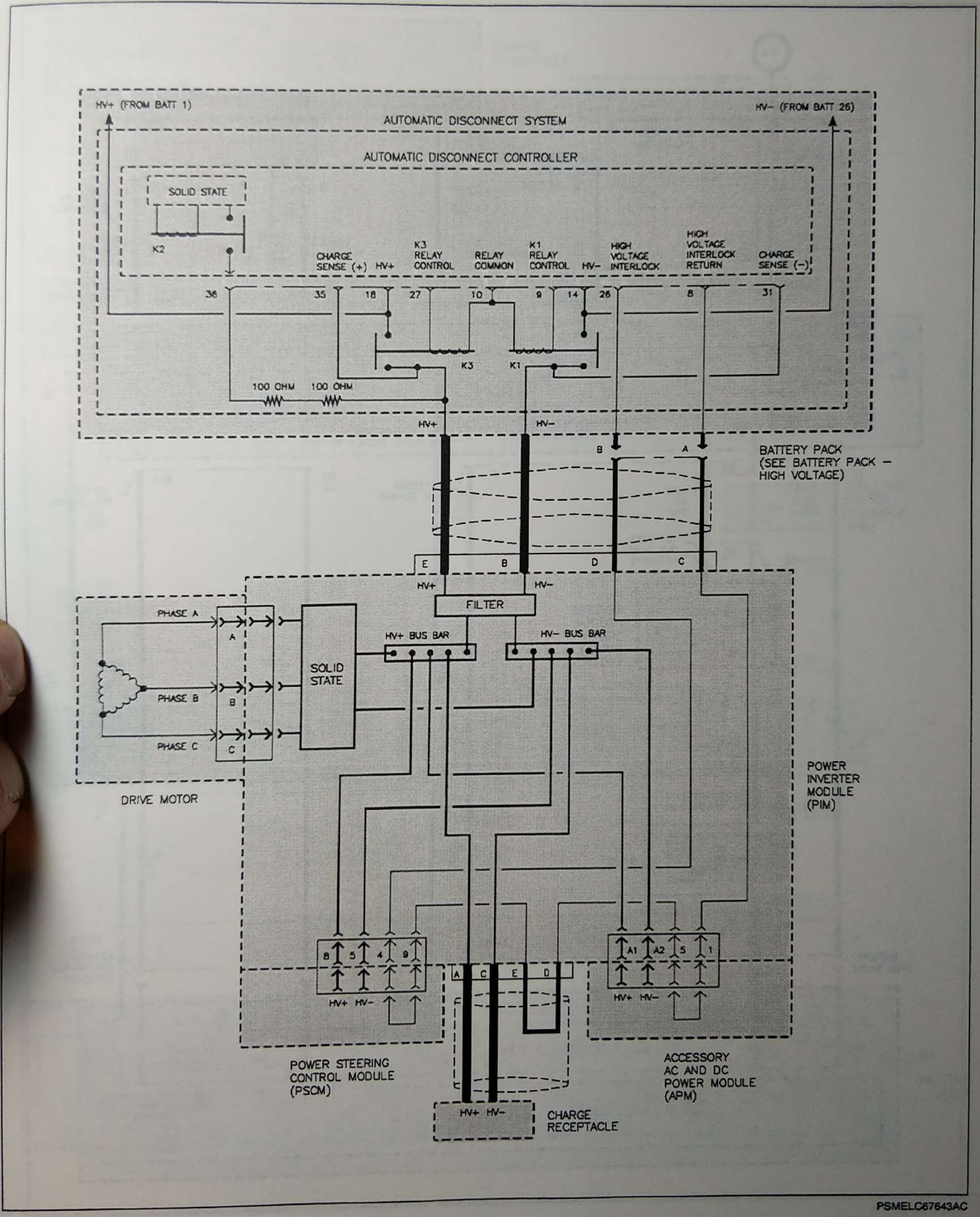
CAUTION: MAKE SURE WHEN INSTALLING THE TOP COVERS THAT THE VENT HARNESS DOES NOT GET PINCHED. PINCHING THE VENT HARNESS MAY CAUSE THE VENT SYSTEM TO FUNCTION INCORRECTLY.

9. Install the battery pack top covers.

Torque: 10 N•m (89 in-lbs)
(3 N•m [27 in-lbs] pack top to manual disconnect)

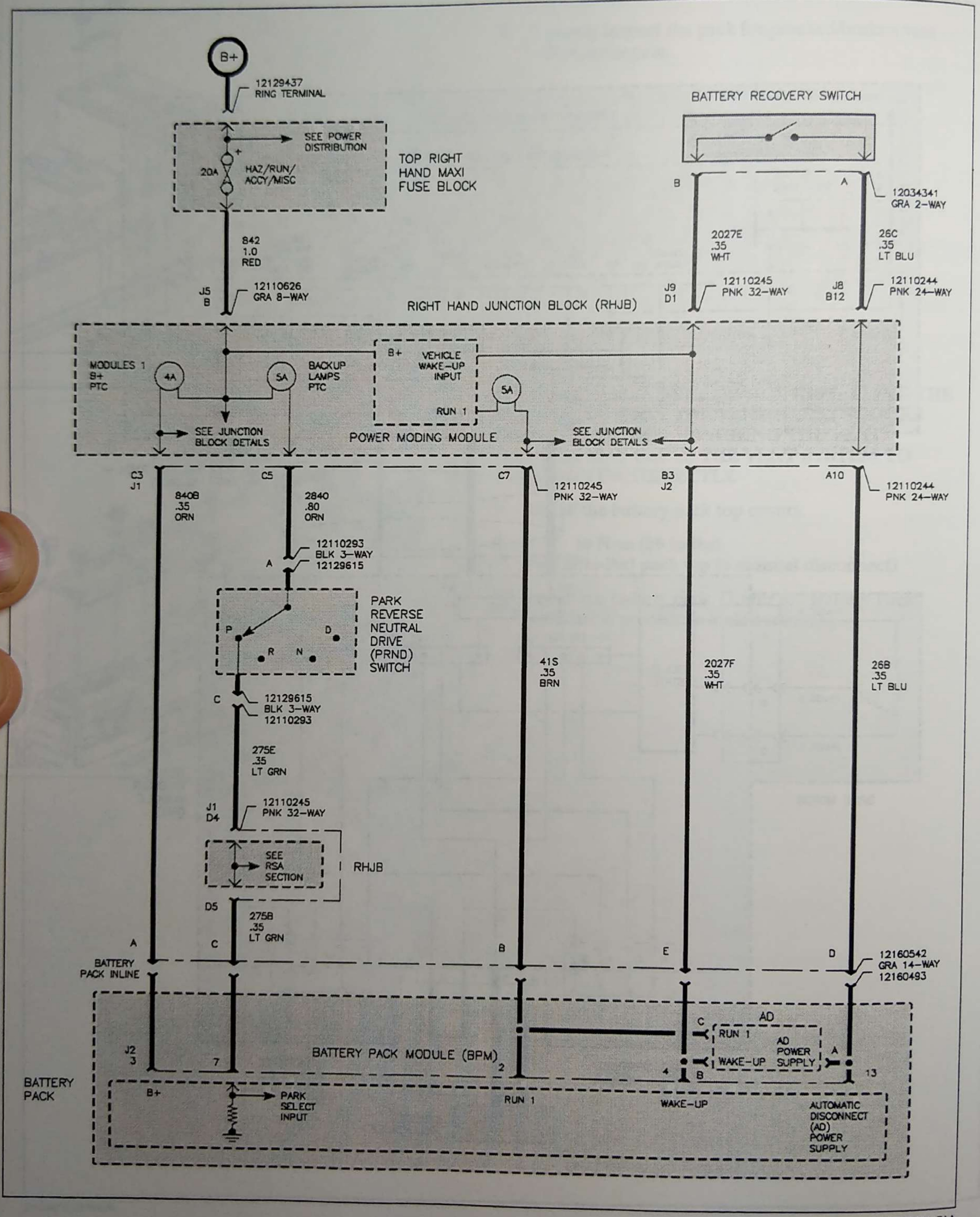
10. Install the battery pack. (Refer to “Battery Pack” installation procedure in this manual.)

PROPULSION (HIGH VOLTAGE)


HV+ (FROM BATT 1)
HV– (FROM BATT 26)
AUTOMATIC DISCONNECT SYSTEM
AUTOMATIC DISCONNECT CONTROLLER
SOLID STATE
K2
CHARGE SENSE (+)
HV+
K3 RELAY CONTROL
RELAY COMMON
K1 RELAY CONTROL
HV–
HIGH VOLTAGE INTERLOCK
HIGH VOLTAGE INTERLOCK RETURN
CHARGE SENSE (–)
36
35
18
27
10
9
14
26
8
31
K3
K1
100 OHM
100 OHM
HV+
HV–
B
A
BATTERY PACK (SEE BATTERY PACK – HIGH VOLTAGE)
E
B
D
C
HV+
HV–
FILTER
HV+ BUS BAR
HV– BUS BAR
PHASE A
PHASE B
PHASE C
A
B
C
SOLID STATE
DRIVE MOTOR
POWER INVERTER MODULE (PIM)
8
5
4
9
HV+
HV–
A
C
E
D
A1
A2
5
1
HV+
HV–
POWER STEERING CONTROL MODULE (PSCM)
ACCESSORY AC AND DC POWER MODULE (APM)
HV+
HV–
CHARGE RECEPTACLE

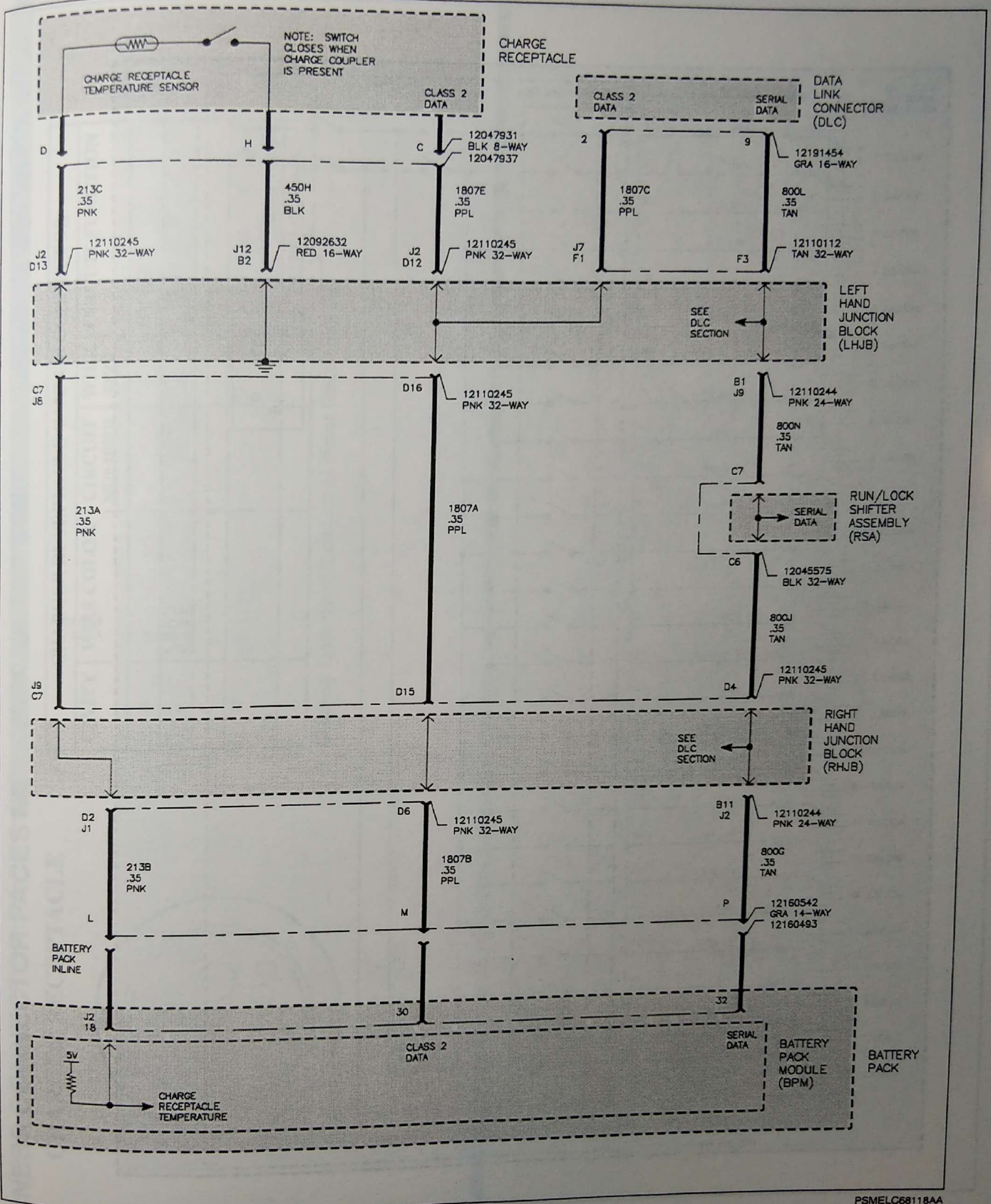
PSMELC67643AC

BATTERY PACK (LOW VOLTAGE)


B+
12129437
RING TERMINAL
SEE POWER DISTRIBUTION
20A
HAZ/RUN/ ACCY/MISC
TOP RIGHT HAND MAXI FUSE BLOCK
842
1.0
RED
J5
B
12110626
GRA 8–WAY
BATTERY RECOVERY SWITCH
B
A
12034341
GRA 2–WAY
2027E
.35
WHT
26C
.35
LT BLU
J9
D1
12110245
PNK 32–WAY
J8
B12
12110244
PNK 24–WAY
RIGHT HAND JUNCTION BLOCK (RHJB)
MODULES 1
B+
PTC
4A
5A
BACKUP
LAMPS
PTC
B+
VEHICLE
WAKE–UP
INPUT
RUN 1
5A
SEE JUNCTION BLOCK DETAILS
POWER MODING MODULE
SEE JUNCTION BLOCK DETAILS
C3
J1
840B
.35
ORN
C5
2840
.80
ORN
C7
12110245
PNK 32–WAY
B3
J2
A10
12110244
PNK 24–WAY
12110293
BLK 3–WAY
12129615
A
P
D
R
N
PARK
REVERSE
NEUTRAL
DRIVE
(PRND)
SWITCH
C
12129615
BLK 3–WAY
12110293
275E
.35
LT GRN
41S
.35
BRN
2027F
.35
WHT
26B
.35
LT BLU
J1
D4
12110245
PNK 32–WAY
SEE RSA SECTION
RHJB
D5
275B
.35
LT GRN
A
C
B
E
D
12160542
GRA 14–WAY
12160493
BATTERY PACK INLINE
AD
C
RUN 1
AD POWER SUPPLY
A
WAKE–UP
B
J2
3
7
BATTERY PACK MODULE (BPM)
2
4
13
BATTERY PACK
B+
PARK SELECT INPUT
RUN 1
WAKE–UP
AUTOMATIC DISCONNECT (AD) POWER SUPPLY

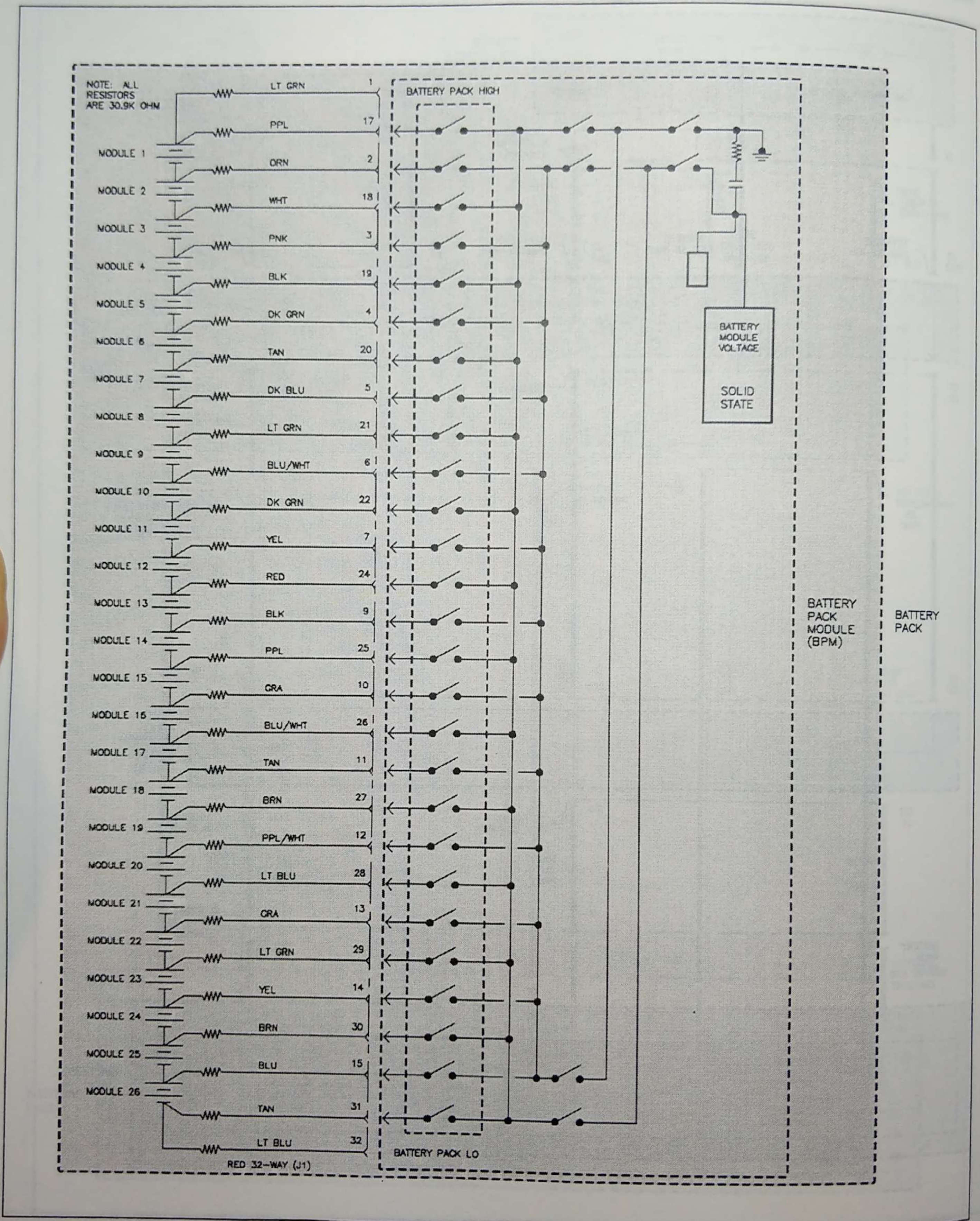
PSMELC68117AA

BATTERY PACK (LOW VOLTAGE – CONT.)


CHARGE RECEPTACLE TEMPERATURE SENSOR
NOTE: SWITCH CLOSES WHEN CHARGE COUPLER IS PRESENT
CLASS 2 DATA
CHARGE RECEPTACLE
CLASS 2 DATA
SERIAL DATA
DATA LINK CONNECTOR (DLC)
D
H
C
12047931
BLK 8–WAY
12047937
2
9
12191454
GRA 16–WAY
213C
.35
PNK
450H
.35
BLK
1807E
.35
PPL
1807C
.35
PPL
800L
.35
TAN
J2
D13
12110245
PNK 32–WAY
J12
B2
12092632
RED 16–WAY
J2
D12
12110245
PNK 32–WAY
J7
F1
F3
12110112
TAN 32–WAY
SEE DLC SECTION
LEFT HAND JUNCTION BLOCK (LHJB)
C7
J8
D16
12110245
PNK 32–WAY
B1
J9
12110244
PNK 24–WAY
800N
.35
TAN
C7
RUN/LOCK SHIFTER ASSEMBLY (RSA)
SERIAL DATA
213A
.35
PNK
1807A
.35
PPL
C6
12045575
BLK 32–WAY
800J
.35
TAN
J9
C7
D15
D4
12110245
PNK 32–WAY
SEE DLC SECTION
RIGHT HAND JUNCTION BLOCK (RHJB)
D2
J1
D6
12110245
PNK 32–WAY
B11
J2
12110244
PNK 24–WAY
213B
.35
PNK
1807B
.35
PPL
800G
.35
TAN
L
M
P
12160542
GRA 14–WAY
12160493
BATTERY PACK INLINE
J2
18
30
32
5V
CHARGE RECEPTACLE TEMPERATURE
CLASS 2 DATA
SERIAL DATA
BATTERY PACK MODULE (BPM)
BATTERY PACK

PSMELC68118AA

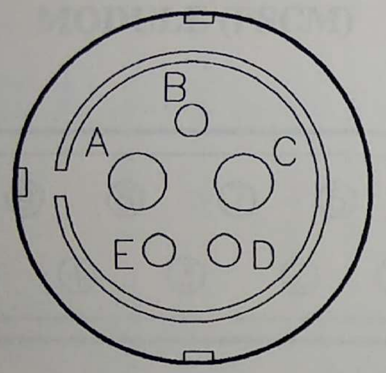
BATTERY PACK (LOW VOLTAGE–CONT.)


NOTE: ALL RESISTORS ARE 30.9K OHM
MODULE 1
MODULE 2
MODULE 3
MODULE 4
MODULE 5
MODULE 6
MODULE 7
MODULE 8
MODULE 9
MODULE 10
MODULE 11
MODULE 12
MODULE 13
MODULE 14
MODULE 15
MODULE 16
MODULE 17
MODULE 18
MODULE 19
MODULE 20
MODULE 21
MODULE 22
MODULE 23
MODULE 24
MODULE 25
MODULE 26
LT GRN 1
PPL 17
ORN 2
WHT 18
PNK 3
BLK 19
DK GRN 4
TAN 20
DK BLU 5
LT GRN 21
BLU/WHT 6
DK GRN 22
YEL 7
RED 24
BLK 9
PPL 25
GRA 10
BLU/WHT 26
TAN 11
BRN 27
PPL/WHT 12
LT BLU 28
GRA 13
LT GRN 29
YEL 14
BRN 30
BLU 15
TAN 31
LT BLU 32
RED 32-WAY (J1)
BATTERY PACK HIGH
BATTERY PACK LO
BATTERY MODULE VOLTAGE
SOLID STATE
BATTERY PACK MODULE (BPM)
BATTERY PACK

PSMELC68122AB

HARNESS CONNECTOR FACES

CHARGER RECEPTACLE



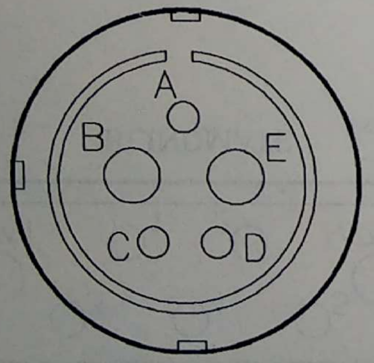
CANNON CONNECTOR

PSMELC68239AA

CHARGER RECEPTACLE CANNON CONNECTOR				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A				HV (+)
B				
C				HV (–)
D				HV INTERLOCK RETURN (–)
E				HV INTERLOCK (+)

Location: Underhood, Left Side of Power Electronics Bay

BATTERY PACK



CANNON CONNECTOR

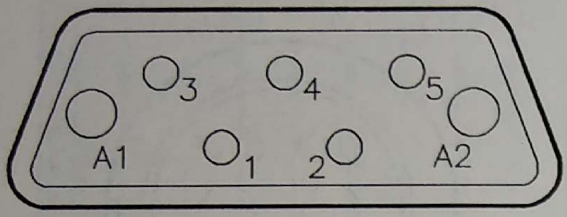
PSMELC68240AA

BATTERY PACK CANNON CONNECTOR				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A				
B				HV–
C				HV INTERLOCK RETURN (–)
D				HV INTERLOCK (+)
E				HV (+)

Location: Underhood, Rear of Power Electronics Bay

HARNESS CONNECTOR FACES

ACCESSORY POWER MODULE (APM)



BLINDMATE

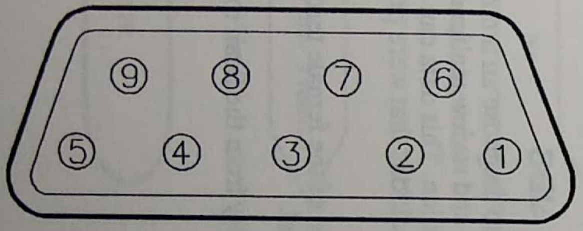
PSMELC68244AA

ACCESSORY POWER MODULE (APM)				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A1				HV BATT +
1				HV INTERLOCK RETURN –
2				
3				
4				
5				HV INTERLOCK +
A2				HV BATT –

Location: Underhood, Attached to Lower Left of Power Electronics Bay

HARNESS CONNECTOR FACES

POWER STEERING CONTROL MODULE (PSCM)



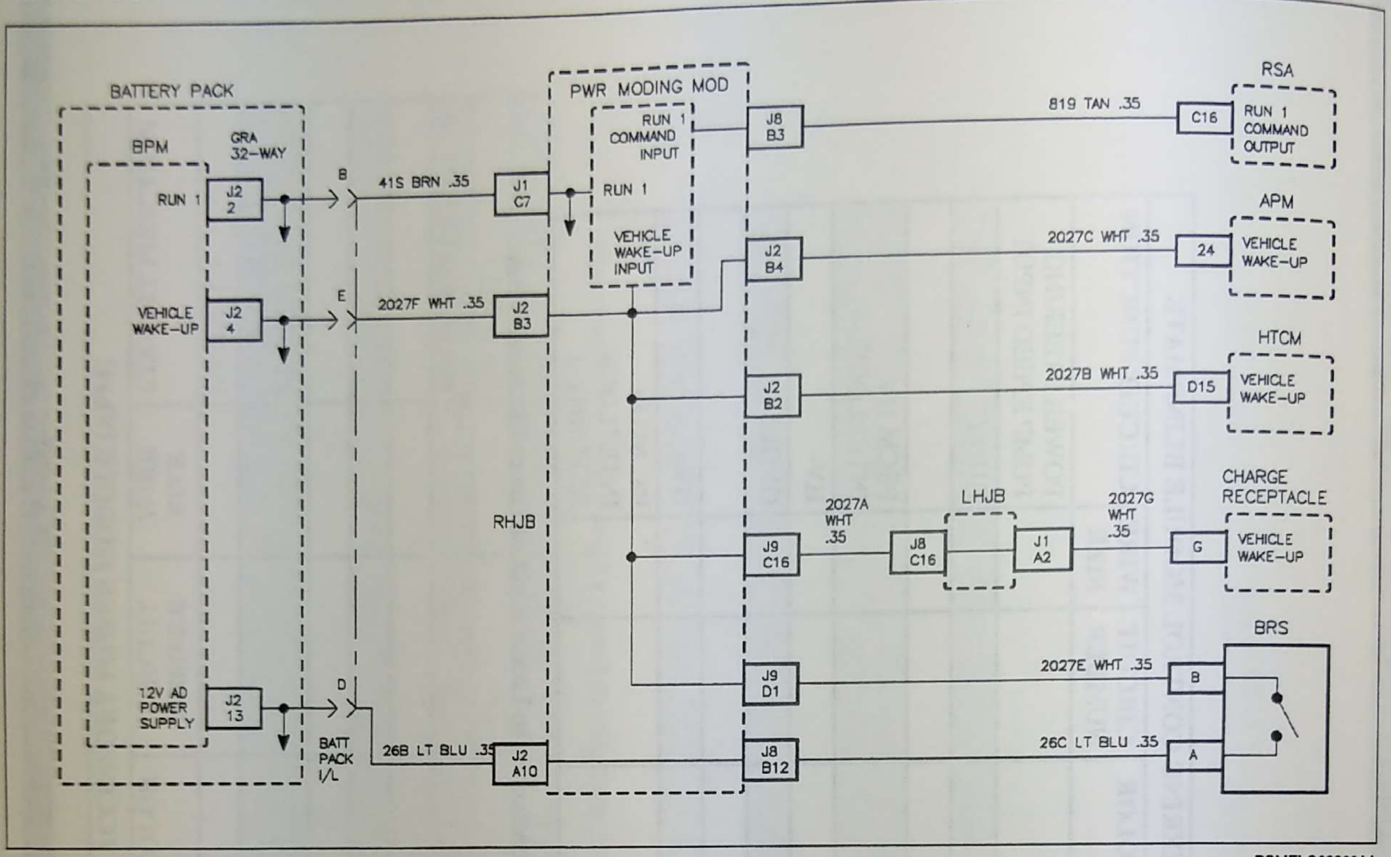
PSMELC68243AA

BLINDMATE

POWER STEERING CONTROL MODULE BLINDMATE				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
1				POWER STEERING PUMP SPEED INPUT
2				RUN 2
3				
4				PSCM HV INTERLOCK (+)
5				HV–
6				GROUND
7				
8				HV+
9				PSCM HV INTERLOCK RETURN (–)

Location: Underhood Attached to Lower Right of Power Electronics Bay.

DTC 281 – RUN 1 FAULT OPEN/SHORT TO GROUND


BATTERY PACK
BPM
GRA 32-WAY
RUN 1
J2 2
VEHICLE WAKE-UP
J2 4
12V AD POWER SUPPLY
J2 13
B
E
D
BATT PACK I/L
41S BRN .35
2027F WHT .35
26B LT BLU .35
J1 C7
J2 B3
J2 A10
RHJB
PWR MODING MOD
RUN 1 COMMAND INPUT
RUN 1
VEHICLE WAKE-UP INPUT
J8 B3
J2 B4
J2 B2
J9 C16
J9 D1
J8 B12
819 TAN .35
2027C WHT .35
2027B WHT .35
2027A WHT .35
LHJB
J8 C16
J1 A2
2027G WHT .35
2027E WHT .35
26C LT BLU .35
RSA
C16
RUN 1 COMMAND OUTPUT
APM
24
VEHICLE WAKE-UP
HTCM
D15
VEHICLE WAKE-UP
CHARGE RECEPTACLE
G
VEHICLE WAKE-UP
BRS
B
A

PSMELC68202AA

RUN 1 FAULT OPEN/SHORT TO GROUND

When the vehicle is powered On, the run/lock shifter assembly (RSA) will send out Run 1 to the battery pack module (BPM). The BPM will wake up when it receives the Run 1 (12 volts) signal.

DTC PARAMETERS

The battery pack module (BPM) will set the DTC if propulsion control module (PCM) or HPVS thermal control module (HTCM) and vehicle wakeup is false, but they are communicating on the universal asynchronous receiver transmitter (UART) line for one minute and the BPM did not receive Run 1.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

None

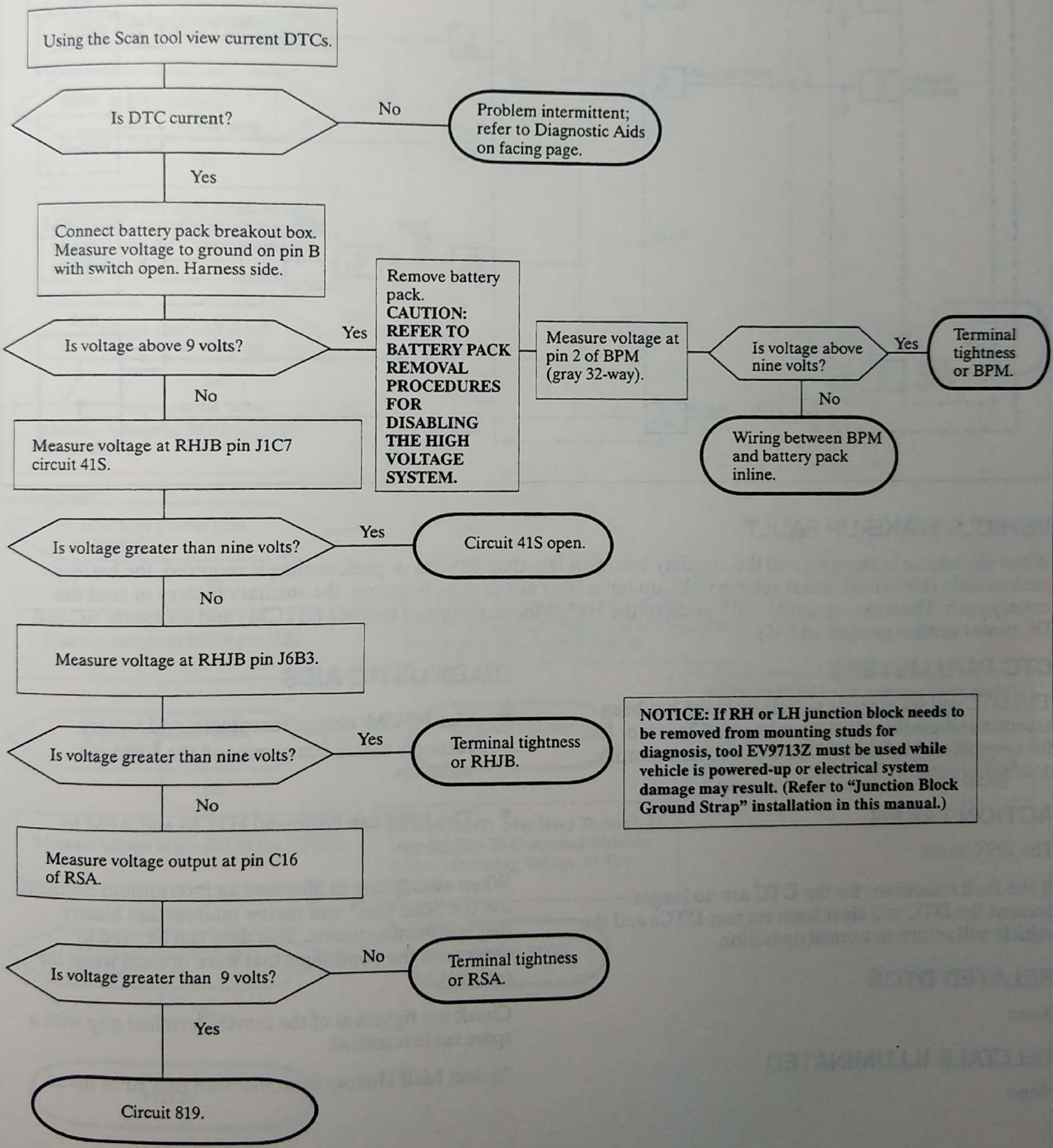
DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the code set.

Check the tightness of the female terminal grip with a spare male terminal.

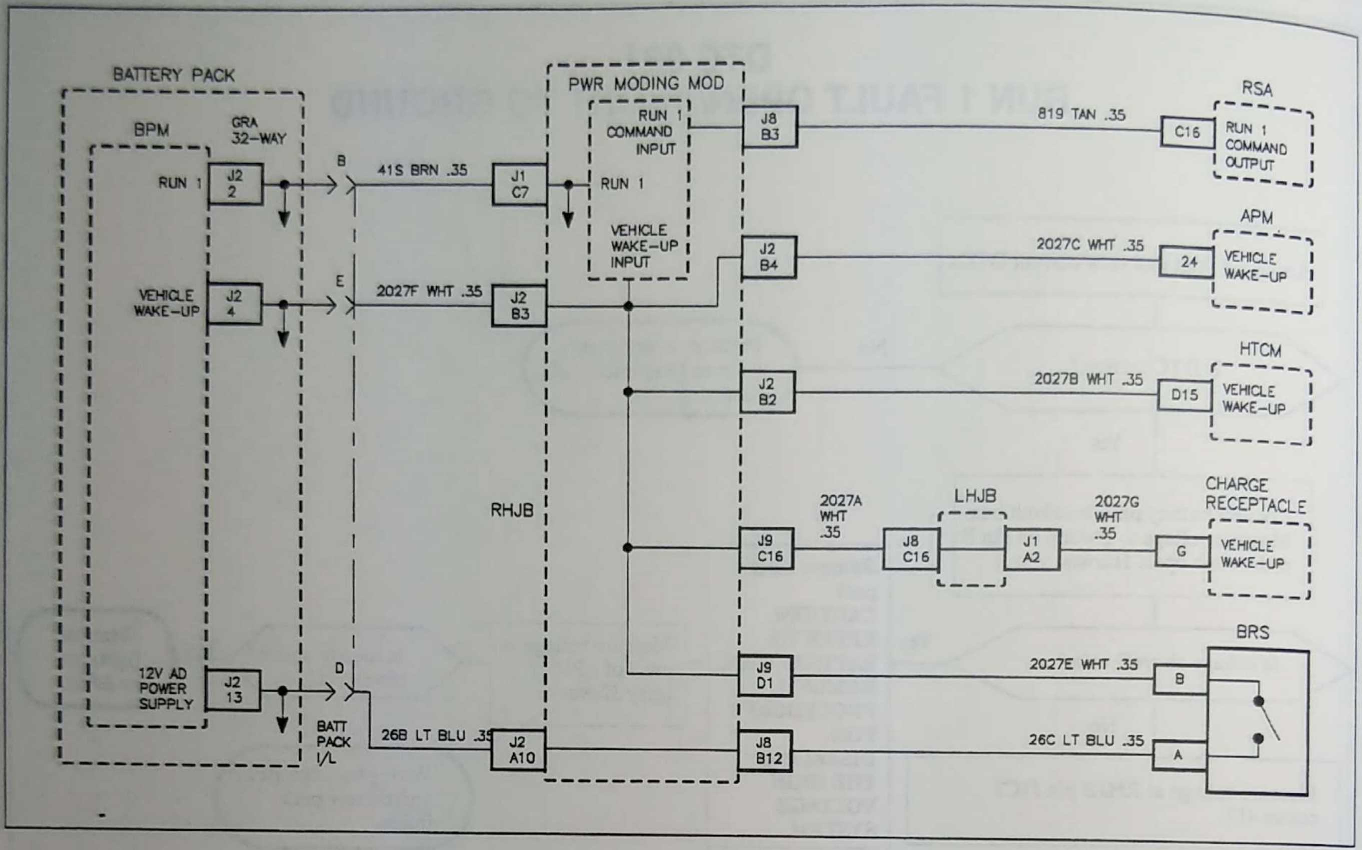
*Select Malf History from the Scan tool BPM menu.

DTC 281
RUN 1 FAULT OPEN/SHORT TO GROUND


Using the Scan tool view current DTCs.
Is DTC current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Connect battery pack breakout box. Measure voltage to ground on pin B with switch open. Harness side.
Is voltage above 9 volts?
Yes
Remove battery pack.
CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.
Measure voltage at pin 2 of BPM (gray 32-way).
Is voltage above nine volts?
Yes
Terminal tightness or BPM.
No
Wiring between BPM and battery pack inline.
No
Measure voltage at RHJB pin J1C7 circuit 41S.
Is voltage greater than nine volts?
Yes
Circuit 41S open.
No
Measure voltage at RHJB pin J6B3.
Is voltage greater than nine volts?
Yes
Terminal tightness or RHJB.
No
Measure voltage output at pin C16 of RSA.
Is voltage greater than 9 volts?
No
Terminal tightness or RSA.
Yes
Circuit 819.

NOTICE: If RH or LH junction block needs to be removed from mounting studs for diagnosis, tool EV9713Z must be used while vehicle is powered-up or electrical system damage may result. (Refer to "Junction Block Ground Strap" installation in this manual.)

DTC 282 – VEHICLE WAKE-UP FAULT


BATTERY PACK
BPM
GRA 32–WAY
RUN 1
J2 2
VEHICLE WAKE–UP
J2 4
12V AD POWER SUPPLY
J2 13
B
E
D
BATT PACK I/L
41S BRN .35
2027F WHT .35
26B LT BLU .35
J1 C7
J2 B3
J2 A10
RHJB
PWR MODING MOD
RUN 1 COMMAND INPUT
RUN 1
VEHICLE WAKE–UP INPUT
J8 B3
J2 B4
J2 B2
J9 C16
J9 D1
J8 B12
819 TAN .35
2027C WHT .35
2027B WHT .35
2027A WHT .35
LHJB
J8 C16
J1 A2
2027G WHT .35
2027E WHT .35
26C LT BLU .35
RSA
C16
RUN 1 COMMAND OUTPUT
APM
24
VEHICLE WAKE–UP
HTCM
D15
VEHICLE WAKE–UP
CHARGE RECEPTACLE
G
VEHICLE WAKE–UP
BRS
B
A
PSMELC68202AA

VEHICLE WAKE-UP FAULT

When the vehicle is charging and the auxiliary battery is less than 12 volts or pack cooling is required, the battery pack module (BPM) will assert vehicle wake-up for as long as required to charge the auxiliary battery or cool the battery pack. The wake-up signal will be sent to the HPVS/thermal control module (HTCM) and accessory AC and DC power control module (APM).

DTC PARAMETERS

This DTC will set anytime vehicle wake-up has been asserted and auxiliary battery voltage is 12 volts or less for one minute and the HTCM is not communicating over serial data.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

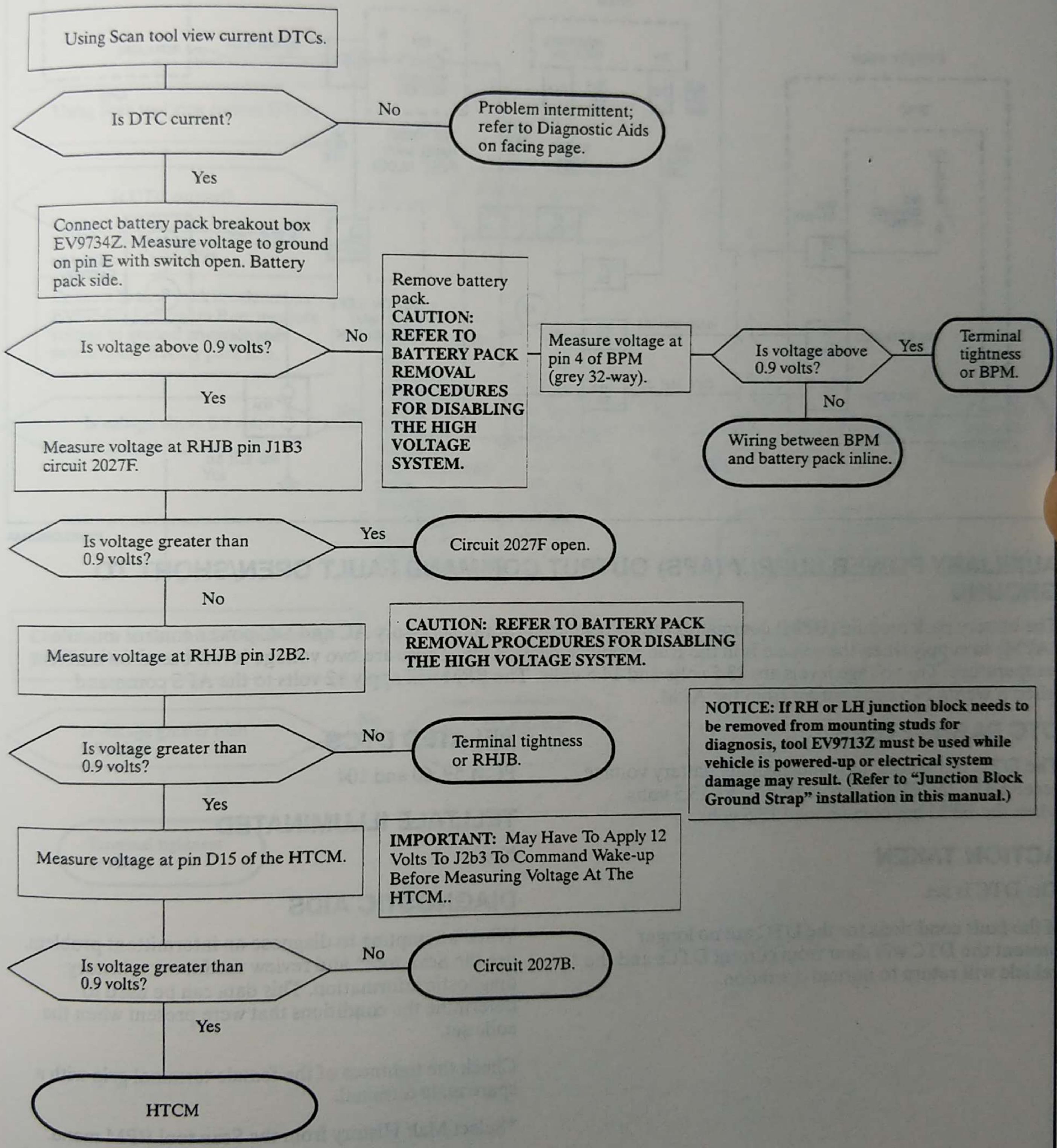
- The HTCM, charge receptacle, and battery recovery switch can command the BPM to wake-up.
- The BPM can command HTCM and APM to wake-up.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the code set.

Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

DTC 282
VEHICLE WAKE-UP FAULT


Using Scan tool view current DTCs.
Is DTC current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Connect battery pack breakout box EV9734Z. Measure voltage to ground on pin E with switch open. Battery pack side.
Is voltage above 0.9 volts?
No
Remove battery pack.
Measure voltage at pin 4 of BPM (grey 32-way).
Is voltage above 0.9 volts?
Yes
Terminal tightness or BPM.
No
Wiring between BPM and battery pack inline.
Yes
Measure voltage at RHJB pin J1B3 circuit 2027F.
Is voltage greater than 0.9 volts?
Yes
Circuit 2027F open.
No
Measure voltage at RHJB pin J2B2.
Is voltage greater than 0.9 volts?
No
Terminal tightness or RHJB.
Yes
Measure voltage at pin D15 of the HTCM.
Is voltage greater than 0.9 volts?
No
Circuit 2027B.
Yes
HTCM

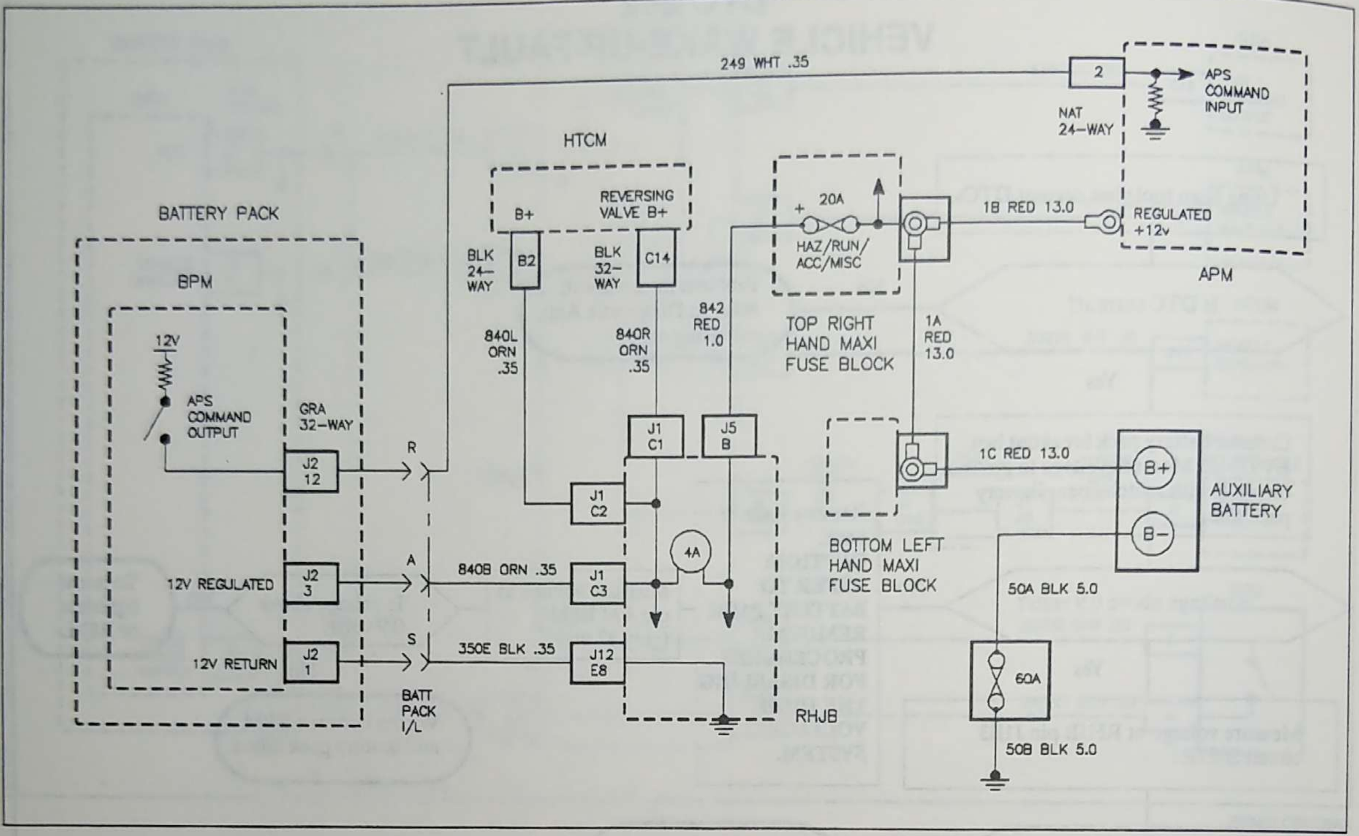
CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.

CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.

NOTICE: If RH or LH junction block needs to be removed from mounting studs for diagnosis, tool EV9713Z must be used while vehicle is powered-up or electrical system damage may result. (Refer to "Junction Block Ground Strap" installation in this manual.)

IMPORTANT: May Have To Apply 12 Volts To J2b3 To Command Wake-up Before Measuring Voltage At The HTCM..

DTC 283 – AUXILIARY POWER SUPPLY (APS) OUTPUT COMMAND FAULT OPEN/SHORT TO GROUND


249 WHT .35
2
APS COMMAND INPUT
NAT 24–WAY
HTCM
REVERSING VALVE B+
B+
20A
HAZ/RUN/ACC/MISC
1B RED 13.0
REGULATED +12v
APM
BATTERY PACK
BPM
BLK 24–WAY
B2
BLK 32–WAY
C14
842 RED 1.0
TOP RIGHT HAND MAXI FUSE BLOCK
1A RED 13.0
12V
APS COMMAND OUTPUT
GRA 32–WAY
840L ORN .35
840R ORN .35
J1 C1
J5 B
J2 12
R
J1 C2
1C RED 13.0
B+
AUXILIARY BATTERY
B–
4A
840B ORN .35
A
12V REGULATED
J2 3
J1 C3
BOTTOM LEFT HAND MAXI FUSE BLOCK
50A BLK 5.0
S
350E BLK .35
12V RETURN
J2 1
J12 E8
60A
BATT PACK I/L
RHJB
50B BLK 5.0

PSMELC68203AA

AUXILIARY POWER SUPPLY (APS) OUTPUT COMMAND FAULT OPEN/SHORT TO GROUND

The battery pack module (BPM) commands the voltage level for the accessory AC and DC power control module (APM) to supply when the vehicle is in the Run mode or APM is On. There are two voltage levels based on ambient temperature. The voltage levels are 13.5 volts and 14.5 volts. The BPM will apply 12 volts to the APS command when it wants 14.5 volts output from the APM.

DTC PARAMETERS

The DTC will set any time the auxiliary battery voltage received by the BPM is not within 12.5–13.5 volts when the BPM has commanded 13.5 volts.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 59, 60 and 104

TELLTALE ILLUMINATED

None

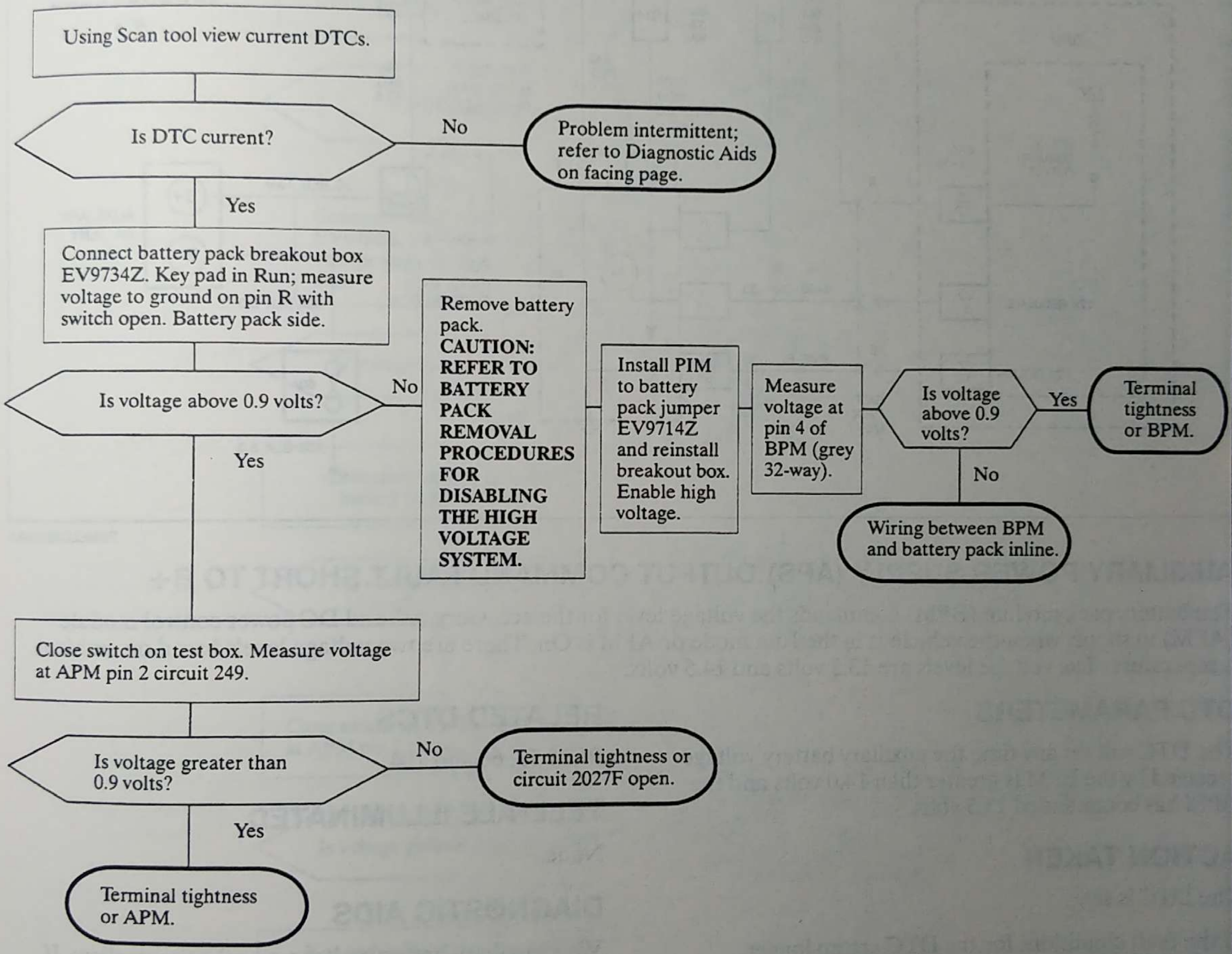
DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the code set.

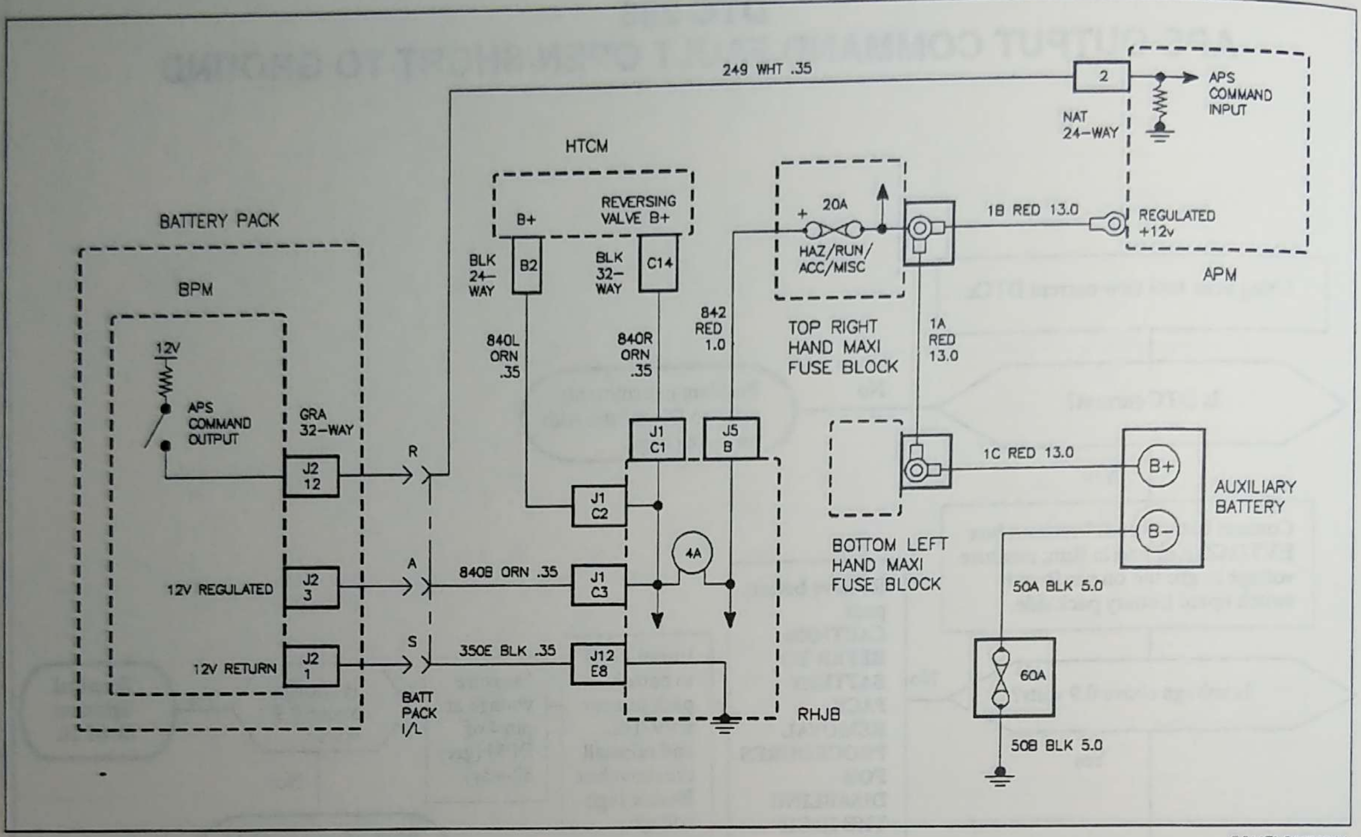
Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

DTC 283
APS OUTPUT COMMAND FAULT OPEN/SHORT TO GROUND


Using Scan tool view current DTCs.
Is DTC current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Connect battery pack breakout box EV9734Z. Key pad in Run; measure voltage to ground on pin R with switch open. Battery pack side.
Is voltage above 0.9 volts?
No
Remove battery pack. CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM.
Install PIM to battery pack jumper EV9714Z and reinstall breakout box. Enable high voltage.
Measure voltage at pin 4 of BPM (grey 32-way).
Is voltage above 0.9 volts?
Yes
Terminal tightness or BPM.
No
Wiring between BPM and battery pack inline.
Yes
Close switch on test box. Measure voltage at APM pin 2 circuit 249.
Is voltage greater than 0.9 volts?
No
Terminal tightness or circuit 2027F open.
Yes
Terminal tightness or APM.

DTC 284 – AUXILIARY POWER SUPPLY (APS) OUTPUT COMMAND FAULT SHORT TO B+


249 WHT .35
2
APS COMMAND INPUT
NAT 24–WAY
HTCM
REVERSING VALVE B+
B+
20A
HAZ/RUN/ACC/MISC
18 RED 13.0
REGULATED +12v
APM
BATTERY PACK
BPM
BLK 24–WAY
B2
BLK 32–WAY
C14
842 RED 1.0
TOP RIGHT HAND MAXI FUSE BLOCK
1A RED 13.0
840L ORN .35
840R ORN .35
12V
APS COMMAND OUTPUT
GRA 32–WAY
J1 C1
J5 B
R
J2 12
J1 C2
1C RED 13.0
B+
AUXILIARY BATTERY
B–
4A
BOTTOM LEFT HAND MAXI FUSE BLOCK
A
840B ORN .35
12V REGULATED
J2 3
J1 C3
50A BLK 5.0
S
350E BLK .35
12V RETURN
J2 1
J12 E8
60A
BATT PACK I/L
RHJB
50B BLK 5.0

PSMELC68203AA

AUXILIARY POWER SUPPLY (APS) OUTPUT COMMAND FAULT SHORT TO B+

The battery pack module (BPM) commands the voltage level for the accessory AC and DC power control module (APM) to supply when the vehicle is in the Run mode or APM is On. There are two voltage levels based on ambient temperature. The voltage levels are 13.5 volts and 14.5 volts.

DTC PARAMETERS

The DTC will set any time the auxiliary battery voltage received by the BPM is greater than 14.0 volts and the BPM has commanded 13.5 volts.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 59, 60 and 104

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

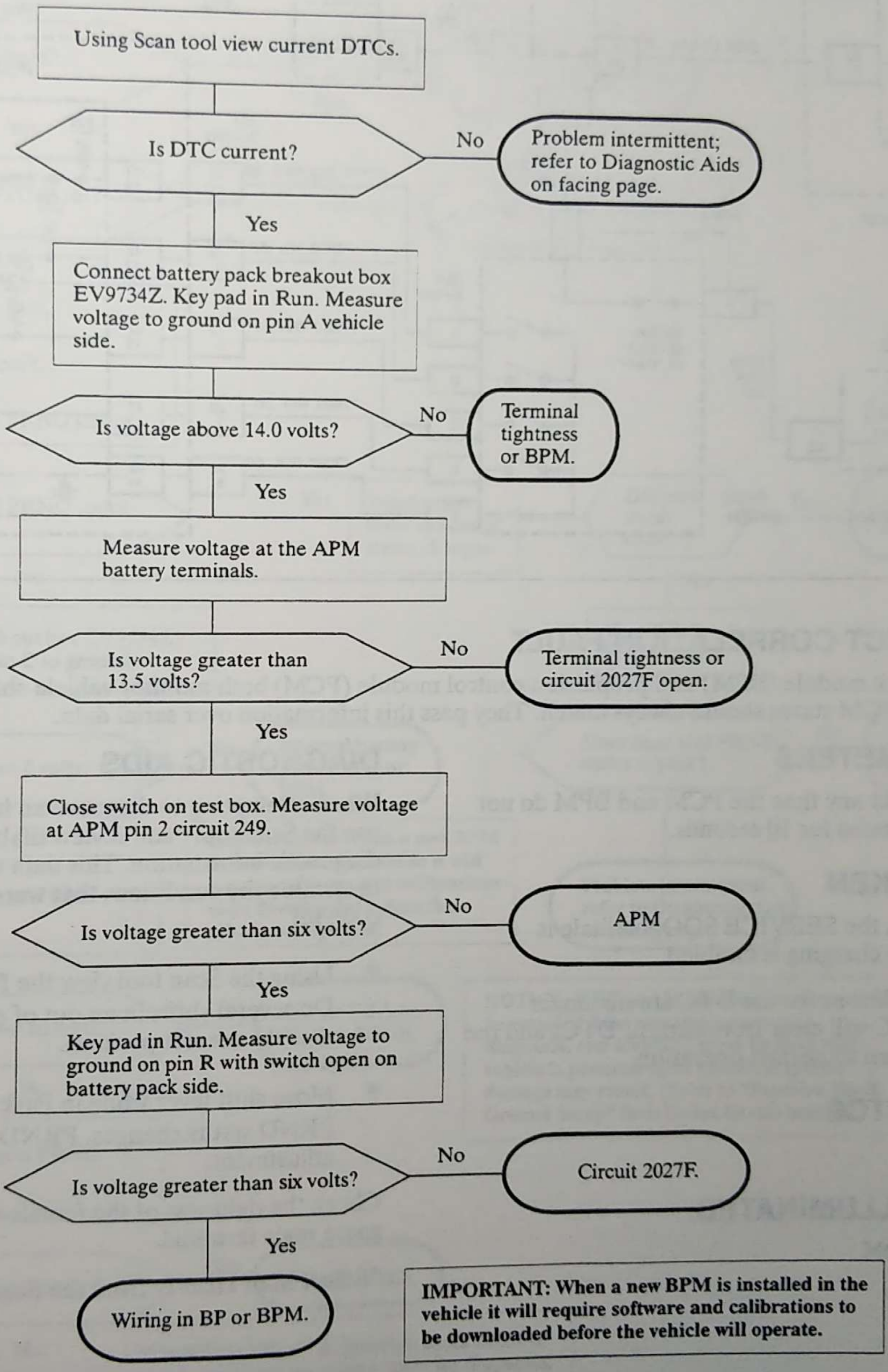
View auxiliary battery voltage on other controllers. If voltage is correct problem is between APM and BPM.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the code set.

Check the tightness of the female terminal grip with a spare male terminal.

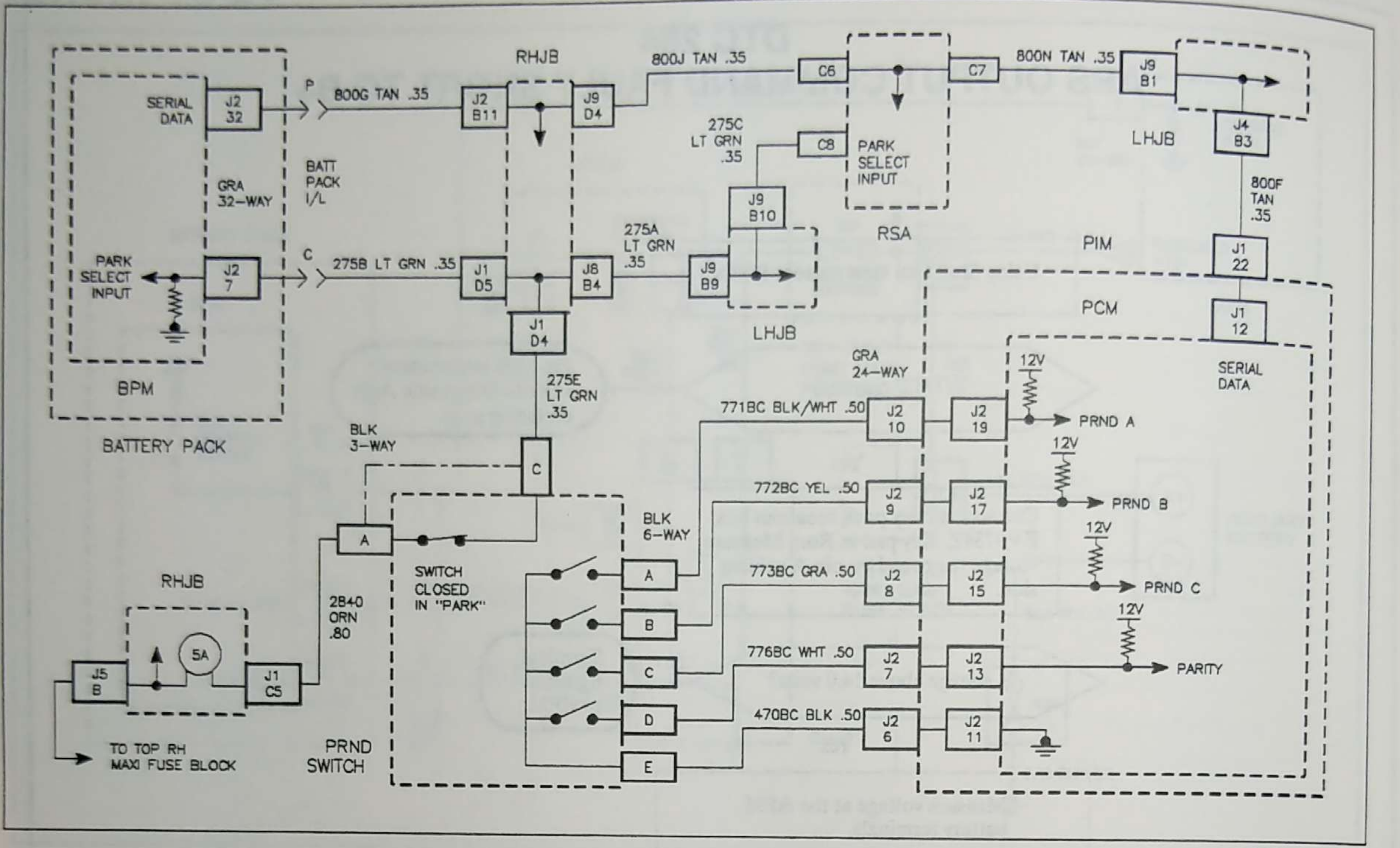
*Select Malf History from the Scan tool BPM menu.

DTC 284
APS OUTPUT COMMAND FAULT SHORT TO B+


Using Scan tool view current DTCs.
Is DTC current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Connect battery pack breakout box EV9734Z. Key pad in Run. Measure voltage to ground on pin A vehicle side.
Is voltage above 14.0 volts?
No
Terminal tightness or BPM.
Yes
Measure voltage at the APM battery terminals.
Is voltage greater than 13.5 volts?
No
Terminal tightness or circuit 2027F open.
Yes
Close switch on test box. Measure voltage at APM pin 2 circuit 249.
Is voltage greater than six volts?
No
APM
Yes
Key pad in Run. Measure voltage to ground on pin R with switch open on battery pack side.
Is voltage greater than six volts?
No
Circuit 2027F.
Yes
Wiring in BP or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 285 – PARK SELECT CORRELATION FAULT


RHJB
800J TAN .35
C6
C7
800N TAN .35
J9 B1
SERIAL DATA
J2 32
P
800G TAN .35
J2 B11
J9 D4
275C LT GRN .35
C8
PARK SELECT INPUT
LHJB
J4 B3
GRA 32–WAY
BATT PACK I/L
J9 B10
800F TAN .35
RSA
PIM
275A LT GRN .35
PARK SELECT INPUT
J2 7
C
275B LT GRN .35
J1 D5
J8 B4
J9 B9
J1 22
PCM
J1 D4
LHJB
J1 12
BPM
275E LT GRN .35
GRA 24–WAY
12V
SERIAL DATA
771BC BLK/WHT .50
J2 10
J2 19
PRND A
BATTERY PACK
BLK 3–WAY
C
12V
772BC YEL .50
J2 9
J2 17
PRND B
A
BLK 6–WAY
12V
RHJB
SWITCH CLOSED IN "PARK"
A
773BC GRA .50
J2 8
J2 15
PRND C
2840 ORN .80
B
12V
5A
J5 B
J1 C5
C
776BC WHT .50
J2 7
J2 13
PARITY
D
470BC BLK .50
J2 6
J2 11
TO TOP RH MAXI FUSE BLOCK
PRND SWITCH
E

PSMELC68204AA

PARK SELECT CORRELATION FAULT

The battery pack module (BPM) and propulsion control module (PCM) both monitor vehicle shift lever park status. The BPM and PCM status should always match. They pass this information over serial data.

DTC PARAMETERS

The DTC will set any time the PCM and BPM do not agree on park status for 10 seconds.

ACTION TAKEN

The DTC is set, the SERVICE SOON telltale is illuminated and charging is disabled.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 61

TELLTALE ILLUMINATED:

SERVICE SOON

DIAGNOSTIC AIDS

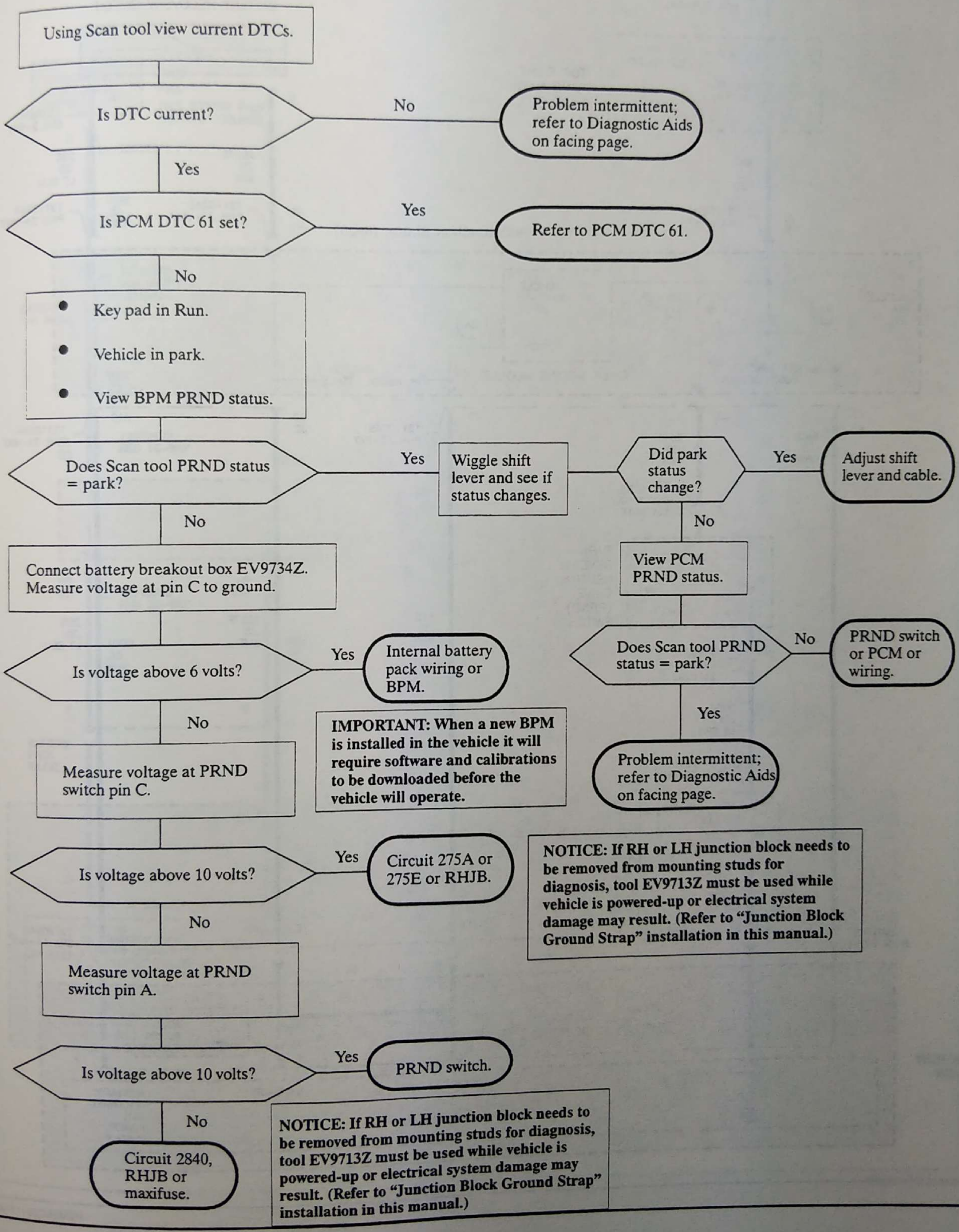
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the code set.

- Using the Scan tool view the PRND mode (BPM). Do several shifts in an out of park and verify BPM sees the correct position.
- Move shift lever while in Park and see if BPM PRND status changes. PRND switch may be out of adjustment.

Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

DTC 285
PARK SELECT CORRELATION FAULT

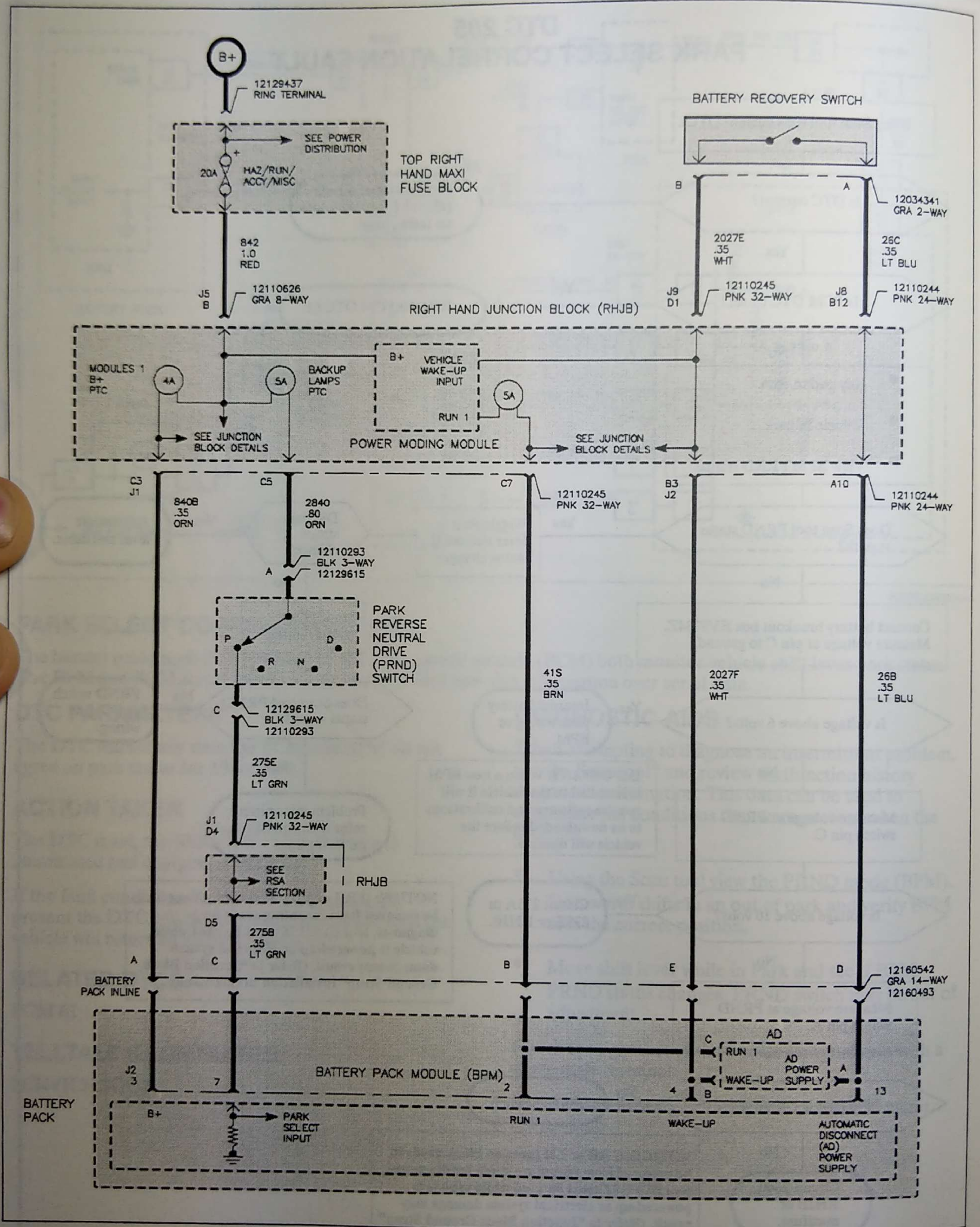

Using Scan tool view current DTCs.
Is DTC current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Is PCM DTC 61 set?
Yes
Refer to PCM DTC 61.
No
• Key pad in Run.
• Vehicle in park.
• View BPM PRND status.
Does Scan tool PRND status = park?
Yes
Wiggle shift lever and see if status changes.
Did park status change?
Yes
Adjust shift lever and cable.
No
View PCM PRND status.
Does Scan tool PRND status = park?
No
PRND switch or PCM or wiring.
Yes
Problem intermittent; refer to Diagnostic Aids on facing page.
No
Connect battery breakout box EV9734Z. Measure voltage at pin C to ground.
Is voltage above 6 volts?
Yes
Internal battery pack wiring or BPM.
No
Measure voltage at PRND switch pin C.
Is voltage above 10 volts?
Yes
Circuit 275A or 275E or RHJB.
No
Measure voltage at PRND switch pin A.
Is voltage above 10 volts?
Yes
PRND switch.
No
Circuit 2840, RHJB or maxifuse.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

NOTICE: If RH or LH junction block needs to be removed from mounting studs for diagnosis, tool EV9713Z must be used while vehicle is powered-up or electrical system damage may result. (Refer to "Junction Block Ground Strap" installation in this manual.)

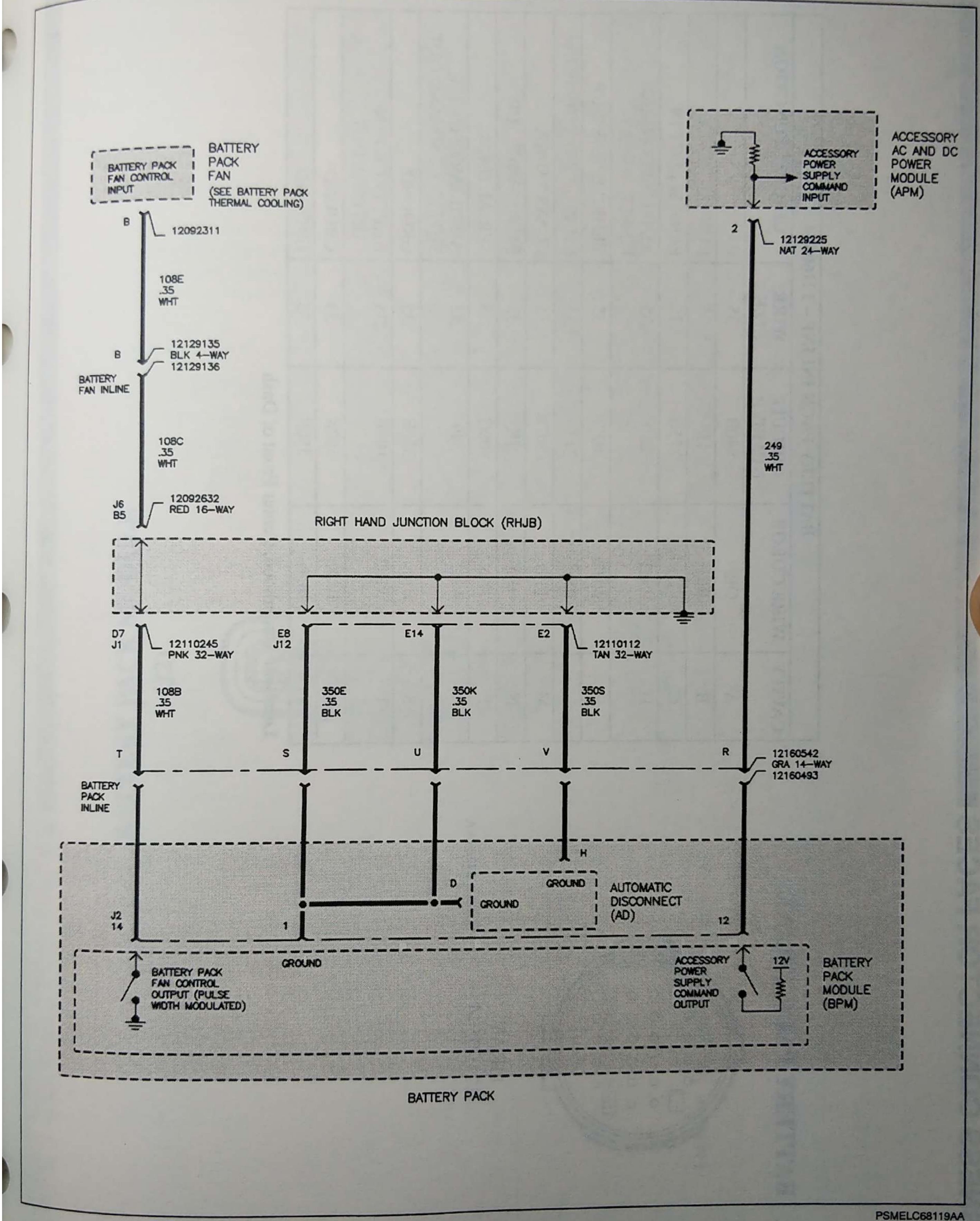
NOTICE: If RH or LH junction block needs to be removed from mounting studs for diagnosis, tool EV9713Z must be used while vehicle is powered-up or electrical system damage may result. (Refer to "Junction Block Ground Strap" installation in this manual.)

BATTERY PACK (LOW VOLTAGE)


B+
12129437
RING TERMINAL
SEE POWER DISTRIBUTION
20A
HAZ/RUN/ACCY/MISC
TOP RIGHT HAND MAXI FUSE BLOCK
842
1.0
RED
J5
B
12110626
GRA 8-WAY
BATTERY RECOVERY SWITCH
B
A
12034341
GRA 2-WAY
2027E
.35
WHT
26C
.35
LT BLU
J9
D1
12110245
PNK 32-WAY
J8
B12
12110244
PNK 24-WAY
RIGHT HAND JUNCTION BLOCK (RHJB)
MODULES 1
B+
PTC
4A
5A
BACKUP LAMPS PTC
B+
VEHICLE WAKE-UP INPUT
RUN 1
5A
SEE JUNCTION BLOCK DETAILS
POWER MODING MODULE
SEE JUNCTION BLOCK DETAILS
C3
J1
840B
.35
ORN
C5
2840
.80
ORN
12110293
BLK 3-WAY
12129615
A
C7
12110245
PNK 32-WAY
B3
J2
A10
12110244
PNK 24-WAY
P
D
R
N
PARK REVERSE NEUTRAL DRIVE (PRND) SWITCH
C
12129615
BLK 3-WAY
12110293
41S
.35
BRN
2027F
.35
WHT
26B
.35
LT BLU
275E
.35
LT GRN
J1
D4
12110245
PNK 32-WAY
SEE RSA SECTION
RHJB
D5
275B
.35
LT GRN
A
C
B
E
D
12160542
GRA 14-WAY
12160493
BATTERY PACK INLINE
AD
C
RUN 1
AD POWER SUPPLY
A
WAKE-UP
B
BATTERY PACK MODULE (BPM)
J2
3
7
2
4
13
BATTERY PACK
B+
PARK SELECT INPUT
RUN 1
WAKE-UP
AUTOMATIC DISCONNECT (AD) POWER SUPPLY

PSMELC68117AA

BATTERY PACK (LOW VOLTAGE)

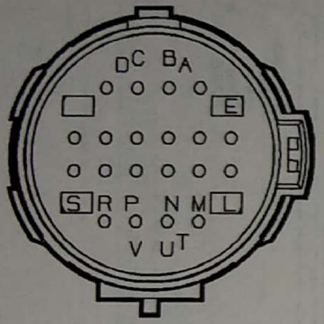

BATTERY PACK FAN CONTROL INPUT
BATTERY PACK FAN
(SEE BATTERY PACK THERMAL COOLING)
B
12092311
108E
.35
WHT
B
12129135
BLK 4–WAY
12129136
BATTERY FAN INLINE
108C
.35
WHT
J6
B5
12092632
RED 16–WAY
RIGHT HAND JUNCTION BLOCK (RHJB)
ACCESSORY POWER SUPPLY COMMAND INPUT
ACCESSORY AC AND DC POWER MODULE (APM)
2
12129225
NAT 24–WAY
249
.35
WHT
D7
J1
12110245
PNK 32–WAY
E8
J12
E14
E2
12110112
TAN 32–WAY
108B
.35
WHT
350E
.35
BLK
350K
.35
BLK
350S
.35
BLK
T
S
U
V
R
12160542
GRA 14–WAY
12160493
BATTERY PACK INLINE
H
D
GROUND
GROUND
AUTOMATIC DISCONNECT (AD)
J2
14
1
12
GROUND
BATTERY PACK FAN CONTROL OUTPUT (PULSE WIDTH MODULATED)
ACCESSORY POWER SUPPLY COMMAND OUTPUT
12V
BATTERY PACK MODULE (BPM)
BATTERY PACK

PSMELC68119AA

CS CamScanner

HARNESS CONNECTOR FACES

BATTERY PACK INLINE



GRAY
12160544

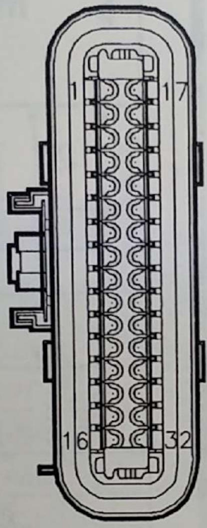
PSMELC67244AA

BATTERY PACK INLINE – 12160544				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	ORN	840B	.35	B+
B	BRN	41S	.35	RUN 1
C	LT GRN	275B	.35	PARK SELECT IN
D	WHT	26B	.35	AUTO DISCONNECT POWER SUPPLY
E	WHT	2027F	.35	VEHICLE WAKE-UP
L	PNK	213B	.35	CHARGE PORT TEMP IN
M	PPL	1807B	.35	CLASS 2 DATA
N	ORN	7K	.35	RUN 1 / WAKE-UP
P	TAN	800G	.35	SERIAL DATA
R	WHT	249	.35	AUXILIARY POWER SUPPLY COMMAND OUT
S	BLK	350E	.35	GROUND
T	WHT	108B	.35	BATT PACK FAN CONTROL OUT
U	BLK	350K	.35	GROUND
V	BLK	350S	.35	GROUND

Location: Underhood, Center Front of Dash

BATTERY PACK MODULE

(J2)



12129025
WITH CLEAR RETAINER

Location: Underbody, in Battery Pack

PSMELC68238AA

HARNESS CONNECTOR FACES

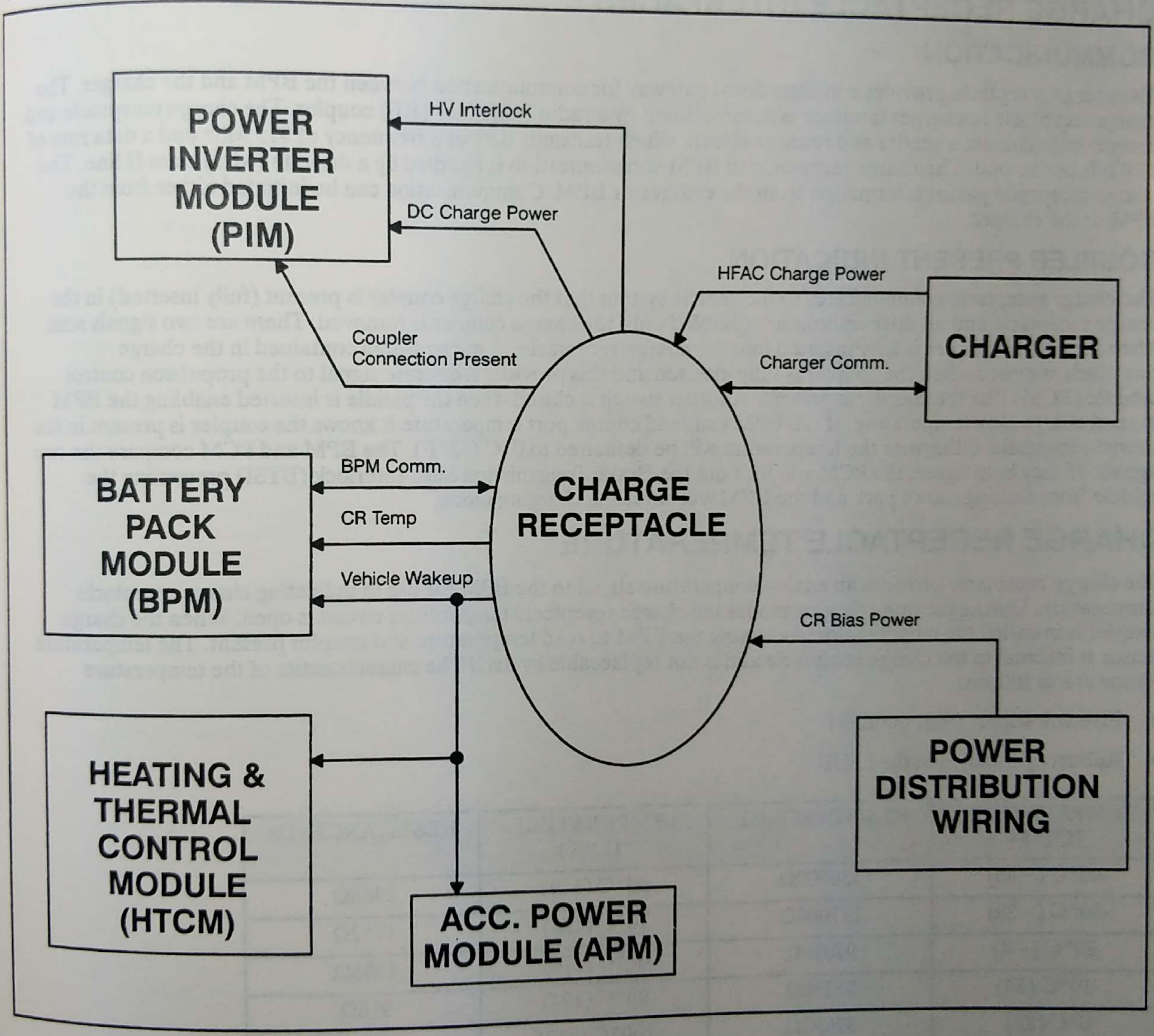
BATTERY PACK MODULE – J2 – 12129025 (WITH RETAINER)				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
1	WHT			GROUND
2	PNK			RUN 1
3	GRA			B+
4	DK BLU			VEHICLE WAKE–UP
5				
6				
7	BLK			PARK SELECT
8	BLK			AD STATE “A”
9	LT BLU			AD STATE “B”
10	BRN			AD STATE “C”
11	DK GRN			AD COMMAND
12	WHT			APS COMMAND
13	PNK			AD POWER SUPPLY
14	TAN			BATT PACK FAN CONTROL
15			–	–
16	YEL			GROUND
17	–	–	–	–
18	GRA			CHARGE RECEPT TEMP
19	–	–	–	–
20	BLK			AIRFLOW DETECT INPUT
21	–	–	–	–
22	LT BLU			MODULE 9 TEMP
23	GRA			MODULE 10 TEMP
24	DK GRN			MODULE 4 TEMP
25	LT GRN			MODULE 6 TEMP
26	PNK			MODULE 1 TEMP
27	PPL			MODULE 3 TEMP
28	TAN			INLET AIR TEMP
29	WHT			GROUND
30	ORN			CLASS 2 DATA
31	DK BLU			GROUND
32	DK GRN			SERIAL DATA

The charge receptacle will interact with other vehicle components to:

- Convert AC power from the charger to DC power for battery charging.
- Provide a bi-directional communications link between the vehicle and the charger.
- Detect the presence of the charge coupler.
- Perform charge receptacle temperature status monitoring.
- Participate in the high voltage (HV) interlock circuit.

EXTERNAL INTERFACE DESCRIPTION

The charge receptacle interfaces to the power inverter module (PIM), battery pack module (BPM), power distribution wiring (vehicle wiring harness), heating and thermal control module (HTCM), accessory power module (APM) and the charger as shown.


POWER INVERTER MODULE (PIM)
HV Interlock
DC Charge Power
Coupler Connection Present
HFAC Charge Power
CHARGER
Charger Comm.
BATTERY PACK MODULE (BPM)
BPM Comm.
CR Temp
Vehicle Wakeup
CHARGE RECEPTACLE
CR Bias Power
HEATING & THERMAL CONTROL MODULE (HTCM)
POWER DISTRIBUTION WIRING
ACC. POWER MODULE (APM)

CHARGE RECEPTACLE

The charge receptacle consists of an integrated high voltage cable, a low voltage signal connector, cooling and vent tube interfaces. The charge receptacle passes high voltage DC to the battery pack via the power inverter module (P1M). The charge receptacle high voltage cable is interlocked and will prevent the system from powering up if the charge receptacle to PIM high voltage connection is disconnected. The primary function of the charge receptacle is to convert commercially supplied power into usable power for the batteries. This is accomplished by using a transformer. The charge coupler is the primary side of the transformer and the charge receptacle is the secondary side of the transformer. When the coupler is fully inserted into the charge receptacle, the charger and BPM are allowed to communicate. The charge receptacle allows communication to the battery pack module (BPM) from the charger by a communication system. When the BPM requests power, the transformer is turned On and the charge port receives from the wall high frequency magnetic flux power. The charge port converts this incoming power to high frequency AC electrical power. Before any power is sent to the battery pack the charge receptacle will convert the high frequency AC power to DC power which is usable by the battery pack. The current sent to the battery pack is in the range of 0 – 22 amps.

CHARGE RECEPTACLE INTERFACES

COMMUNICATION

The charge receptacle provides a bi-directional gateway for communication between the BPM and the charger. The charge receptacle to charger interface is accomplished by a radio frequency (RF) coupler. The charge receptacle and charger both contain a sender and receiver circuit, which transmits data at a frequency of 915 Mhz and a data rate of 10.4 bits per second. The charge receptacle to BPM communication is handled by a discrete (wire) class II line. The charge receptacle passes information from the charger or BPM. Communication can be initiated either from the BPM or the charger.

COUPLER PRESENT INDICATION

The charge receptacle communicates to the vehicle system that the charge coupler is present (fully inserted) in the charge receptacle and all drive options are disabled until the charge coupler is removed. There are two signals sent when the charge coupler is fully inserted into the charge receptacle. A micro switch contained in the charge receptacle is closed when the coupler is fully inserted and this provides a discrete signal to the propulsion control module (PCM) that the coupler is present. Another switch is closed when the paddle is inserted enabling the BPM to read charge port temperature. If the BPM can read charge port temperature it knows the coupler is present in the charge receptacle. Otherwise the temperature will be defaulted to 0°C (32°F). The BPM and PCM compare the two signals. If they both agree, the PCM will lock out the Brake Transmission Shift Interlock (BTSI) preventing the vehicle from shifting out of park and the BPM will enter the charging mode.

CHARGE RECEPTACLE TEMPERATURE

The charge receptacle provides an analog temperature signal to the BPM for use in indicating charge receptacle temperature. During the non-charging modes the charge receptacle temperature circuit is open. When the charge coupler is installed the circuit is closed allowing the BPM to read temperature and coupler present. The temperature sensor is internal to the charge receptacle and is not replaceable by itself The characteristics of the temperature sensor are as follows:

- Five volt supply from the BPM.
- Return (ground) is in the LHJB.

TEMPERATURE °C (°F)	RESISTANCE (Ω)	TEMPERATURE °C (°F)	RESISTANCE (Ω)
-40°C (−40)	336500Ω	60°C (140)	2488Ω
-30°C (−22)	177000Ω	70°C (158)	1752Ω
-20°C (−4)	97070Ω	80°C (176)	1258Ω
-10°C (14)	55330Ω	90°C (194)	918Ω
0°C (32)	32650Ω	100°C (212)	680Ω
10°C (50)	19900Ω	110°C (230)	511Ω
20°C (68)	12490Ω	120°C (248)	389Ω
30°C (86)	8057Ω	130°C (266)	301Ω
40°C (104)	5327Ω	140°C (284)	235Ω
50°C (122)	3603Ω	150°C (302)	185Ω

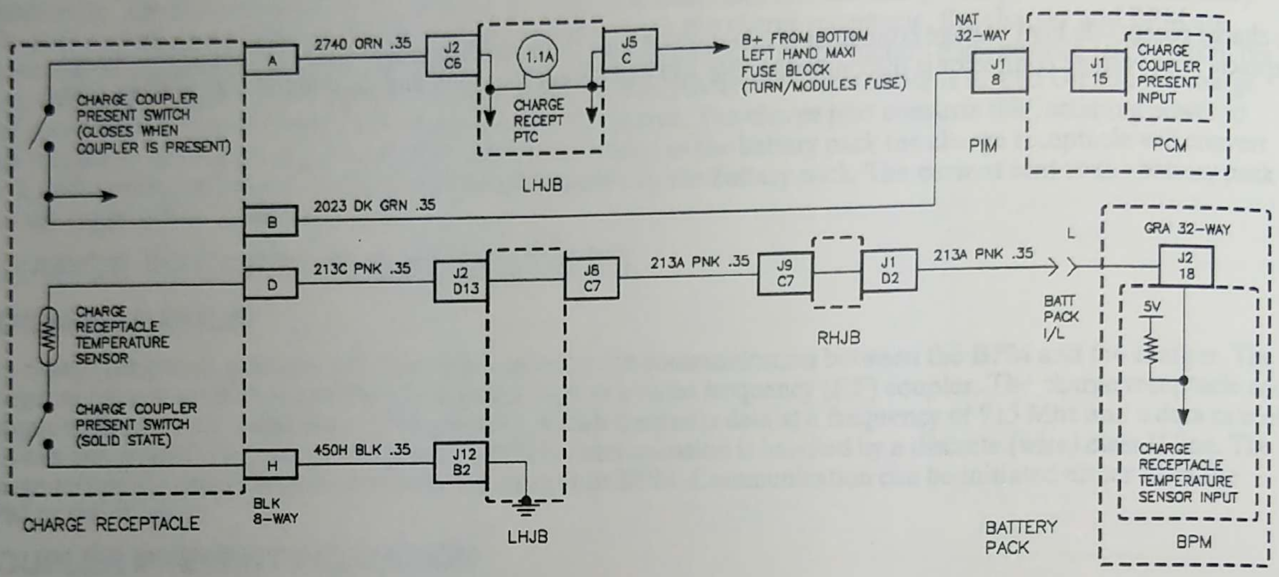
VEHICLE WAKE–UP

When the charge coupler is inserted into the charge receptacle it asserts the wake-up signal for 1.25 seconds to the battery pack module (BPM), Accessory AC and DC power module (APM) and HPVS/thermal control module (HTCM) to wake them up for charging.

HIGH VOLTAGE INTERLOCK

The charge receptacle high voltage connector is interlocked with the auto disconnect (AD) system. If the charge receptacle high voltage connector is disconnected, the AD will detect the open and disable the high voltage relays.

VEHICLE WILL NOT CHARGE, NO DTCS PRESENT AND CHARGER DISPLAYS CONNECT TO VEHICLE

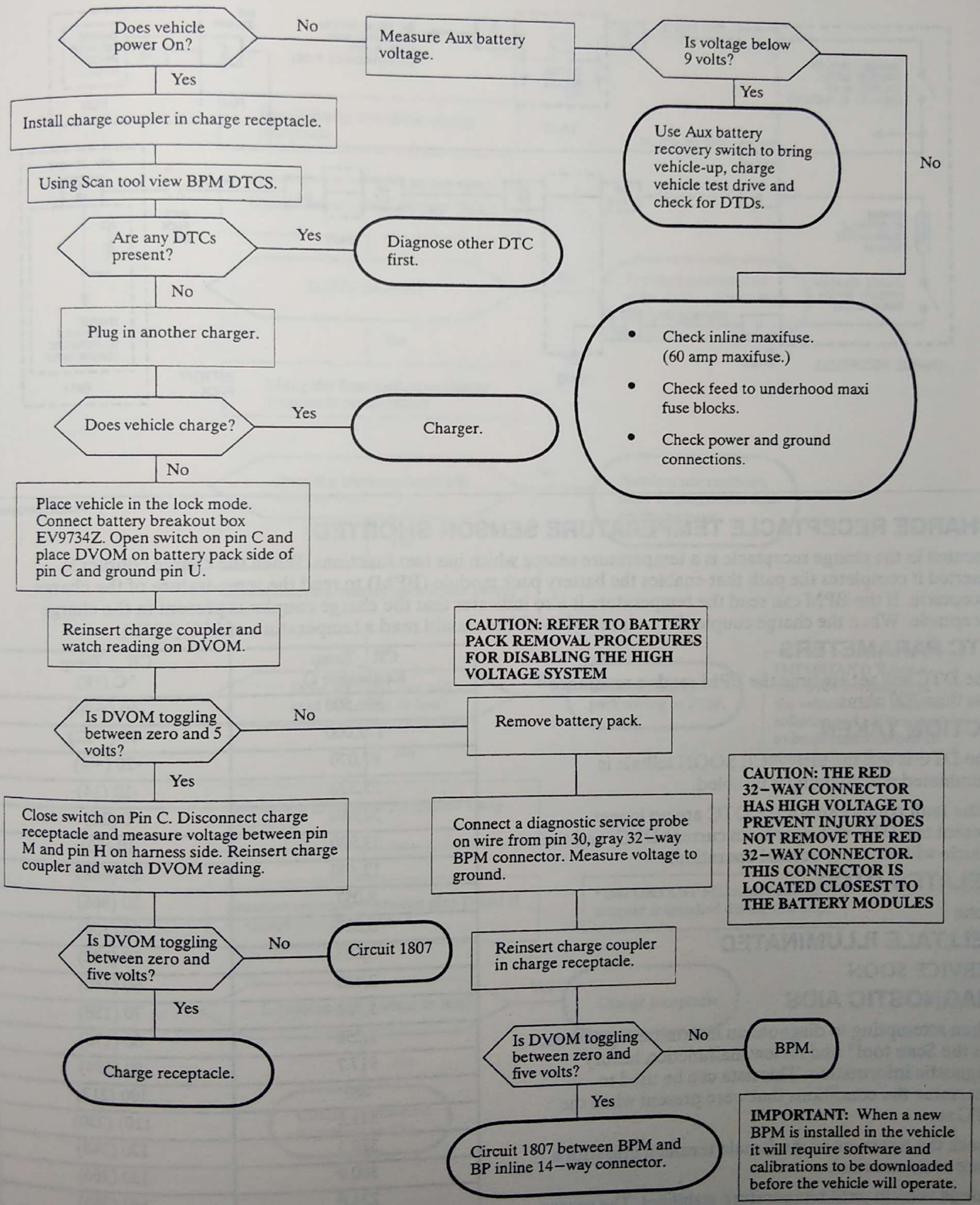

CHARGE COUPLER PRESENT SWITCH (CLOSES WHEN COUPLER IS PRESENT)
CHARGE RECEPTACLE TEMPERATURE SENSOR
CHARGE COUPLER PRESENT SWITCH (SOLID STATE)
CHARGE RECEPTACLE
A
B
D
H
BLK 8-WAY
2740 ORN .35
2023 DK GRN .35
213C PNK .35
450H BLK .35
J2 C6
1.1A
CHARGE RECEPT PTC
J5 C
LHJB
J2 D13
J8 C7
J12 B2
LHJB
B+ FROM BOTTOM LEFT HAND MAXI FUSE BLOCK (TURN/MODULES FUSE)
NAT 32-WAY
J1 8
PIM
J1 15
CHARGE COUPLER PRESENT INPUT
PCM
213A PNK .35
J9 C7
J1 D2
RHJB
213A PNK .35
L
BATT PACK I/L
GRA 32-WAY
J2 18
5V
CHARGE RECEPTACLE TEMPERATURE SENSOR INPUT
BPM
BATTERY PACK

PSMELC68199AA

VEHICLE WILL NOT CHARGE, NO DTCS AND CHARGER DISPLAYS CONNECT TO VEHICLE

When the charger receives communication from the vehicle, the connect to vehicle message will disappear and charging will start. If a failure is detected, the battery pack module (BPM) will set a DTC or the charger will display "Check Charger" or "Check Vehicle." If the charge coupler is inserted and the "Connect to Vehicle" message does not change, the charger is not receiving communication from the vehicle either because the BPM is not sending the message, the message is not reaching the charge receptacle or the charge receptacle is not reporting the message to the charger.

VEHICLE WILL NOT CHARGE, NO DTCS PRESENT AND CHARGER DISPLAYS CONNECT TO VEHICLE

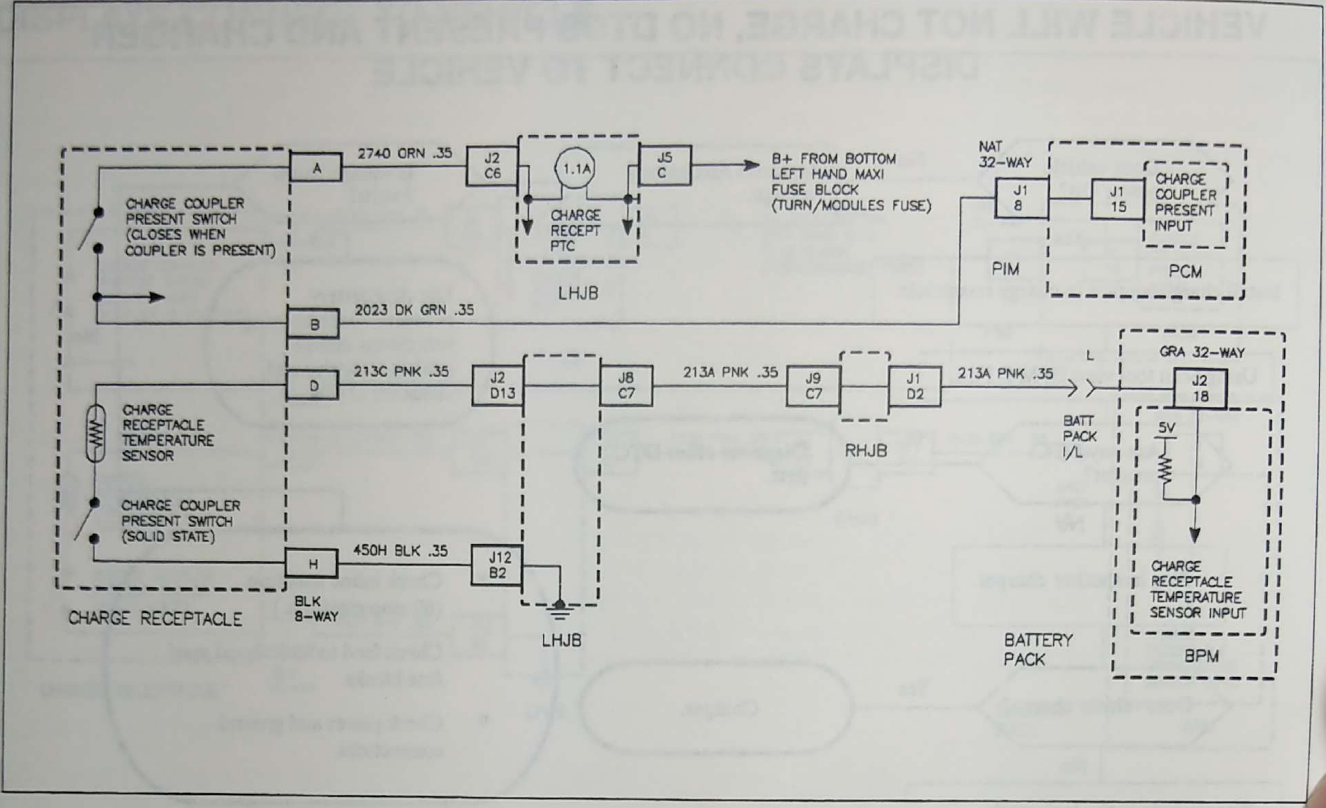

Does vehicle power On?
No
Measure Aux battery voltage.
Is voltage below 9 volts?
Yes
Use Aux battery recovery switch to bring vehicle-up, charge vehicle test drive and check for DTDs.
No
Yes
Install charge coupler in charge receptacle.
Using Scan tool view BPM DTCS.
Are any DTCs present?
Yes
Diagnose other DTC first.
No
Plug in another charger.
• Check inline maxifuse. (60 amp maxifuse.)
• Check feed to underhood maxi fuse blocks.
• Check power and ground connections.
Does vehicle charge?
Yes
Charger.
No
Place vehicle in the lock mode. Connect battery breakout box EV9734Z. Open switch on pin C and place DVOM on battery pack side of pin C and ground pin U.
Reinsert charge coupler and watch reading on DVOM.
Is DVOM toggling between zero and 5 volts?
No
Remove battery pack.
Yes
Close switch on Pin C. Disconnect charge receptacle and measure voltage between pin M and pin H on harness side. Reinsert charge coupler and watch DVOM reading.
Connect a diagnostic service probe on wire from pin 30, gray 32–way BPM connector. Measure voltage to ground.
Is DVOM toggling between zero and five volts?
No
Circuit 1807
Reinsert charge coupler in charge receptacle.
Yes
Is DVOM toggling between zero and five volts?
No
BPM.
Charge receptacle.
Yes
Circuit 1807 between BPM and BP inline 14–way connector.

CAUTION: REFER TO BATTERY PACK REMOVAL PROCEDURES FOR DISABLING THE HIGH VOLTAGE SYSTEM

CAUTION: THE RED 32–WAY CONNECTOR HAS HIGH VOLTAGE TO PREVENT INJURY DOES NOT REMOVE THE RED 32–WAY CONNECTOR. THIS CONNECTOR IS LOCATED CLOSEST TO THE BATTERY MODULES

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 286 – CHARGE RECEPTACLE TEMPERATURE SENSOR SHORTED


2740 ORN .35
A
J2 C6
1.1A
CHARGE RECEPT PTC
J5 C
B+ FROM BOTTOM LEFT HAND MAXI FUSE BLOCK (TURN/MODULES FUSE)
NAT 32–WAY
J1 8
J1 15
CHARGE COUPLER PRESENT INPUT
PIM
PCM
CHARGE COUPLER PRESENT SWITCH (CLOSES WHEN COUPLER IS PRESENT)
LHJB
B
2023 DK GRN .35
D
213C PNK .35
J2 D13
J8 C7
213A PNK .35
J9 C7
J1 D2
213A PNK .35
L
GRA 32–WAY
J2 18
5V
CHARGE RECEPTACLE TEMPERATURE SENSOR
RHJB
BATT PACK I/L
CHARGE COUPLER PRESENT SWITCH (SOLID STATE)
H
450H BLK .35
J12 B2
CHARGE RECEPTACLE TEMPERATURE SENSOR INPUT
CHARGE RECEPTACLE
BLK 8–WAY
LHJB
BATTERY PACK
BPM

PSMELC68199A

CHARGE RECEPTACLE TEMPERATURE SENSOR SHORTED

Located in the charge receptacle is a temperature sensor which has two functions. When the charge coupler is inserted it completes the path that enables the battery pack module (BPM) to read the temperature of the charge receptacle. If the BPM can read the temperature it also indicates that the charge coupler is present in the charge receptacle. When the charge coupler is not inserted the BPM should read a temperature of 0°C (32°F).

DTC PARAMETERS

The DTC will set anytime the BPM reads a resistance less than 300 ohms.

ACTION TAKEN

The DTC is set, the SERVICE SOON telltale is illuminated and charging is disabled.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

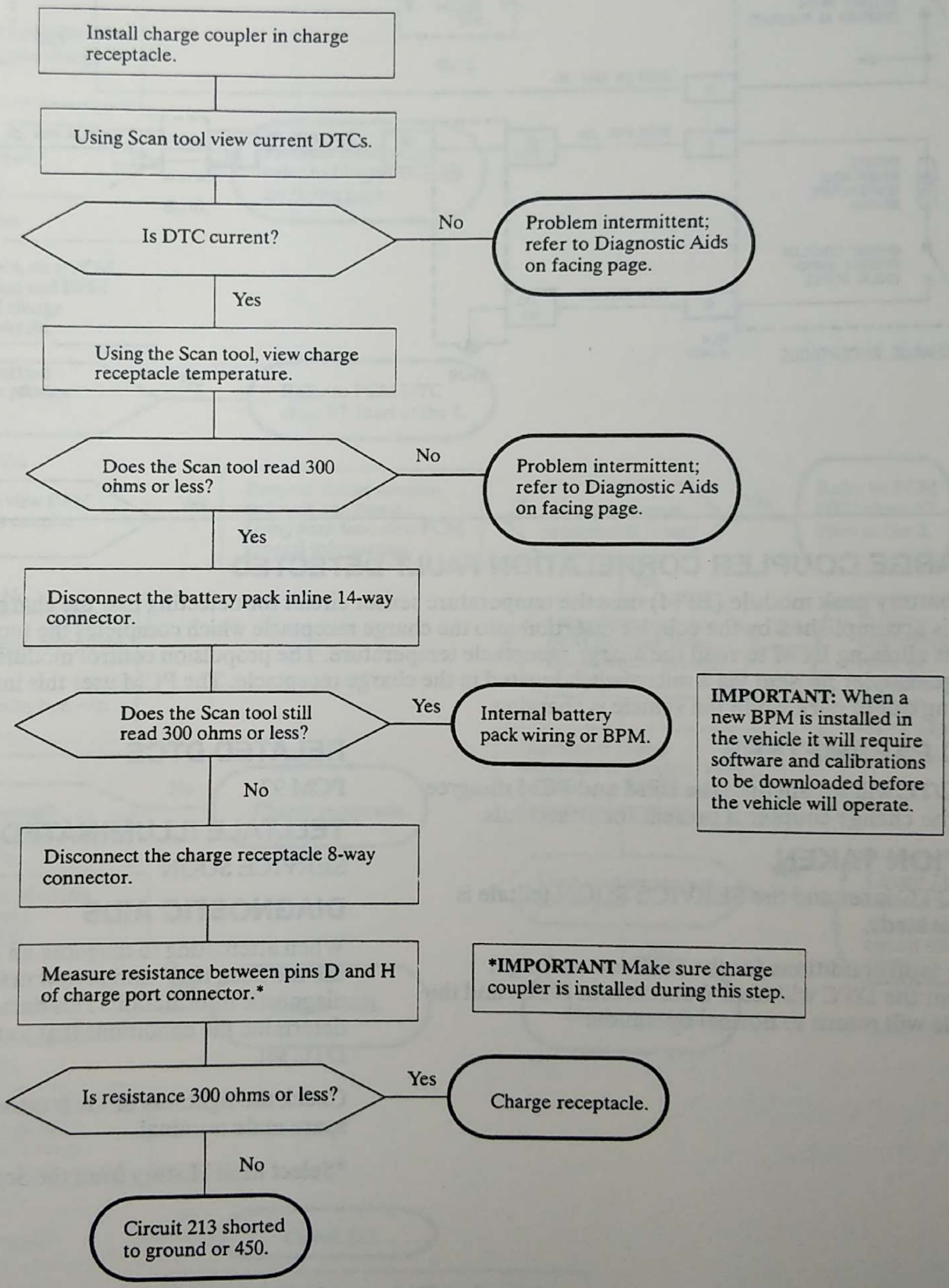
Check the tightness of the female terminal grip with a spare male terminal.

Charge vehicle until temperature stabilizes. The sensor may fail only when hot.

*Select Malf History from the Scan tool BPM menu.

CR _ Temp Resistance Ω	CR _ Temp °C (°F)
336,500	-40 (−40)
177,000	-30 (−22)
97,070	-20 (−4)
55,330	-10 (14)
32,650	0 (32)
19,900	10 (50)
12,490	20 (688)
8,057	30 (866)
5,327	40 (104)
3,603	50 (122)
2,488	60 (140)
1,752	70 (158)
1,258	80 (176)
917.7	90 (194)
680	100 (212)
511.2	110) (230)
389.3	120 (248)
300.9	130 (266)
234.8	140 (284)
185.3	150 (302)

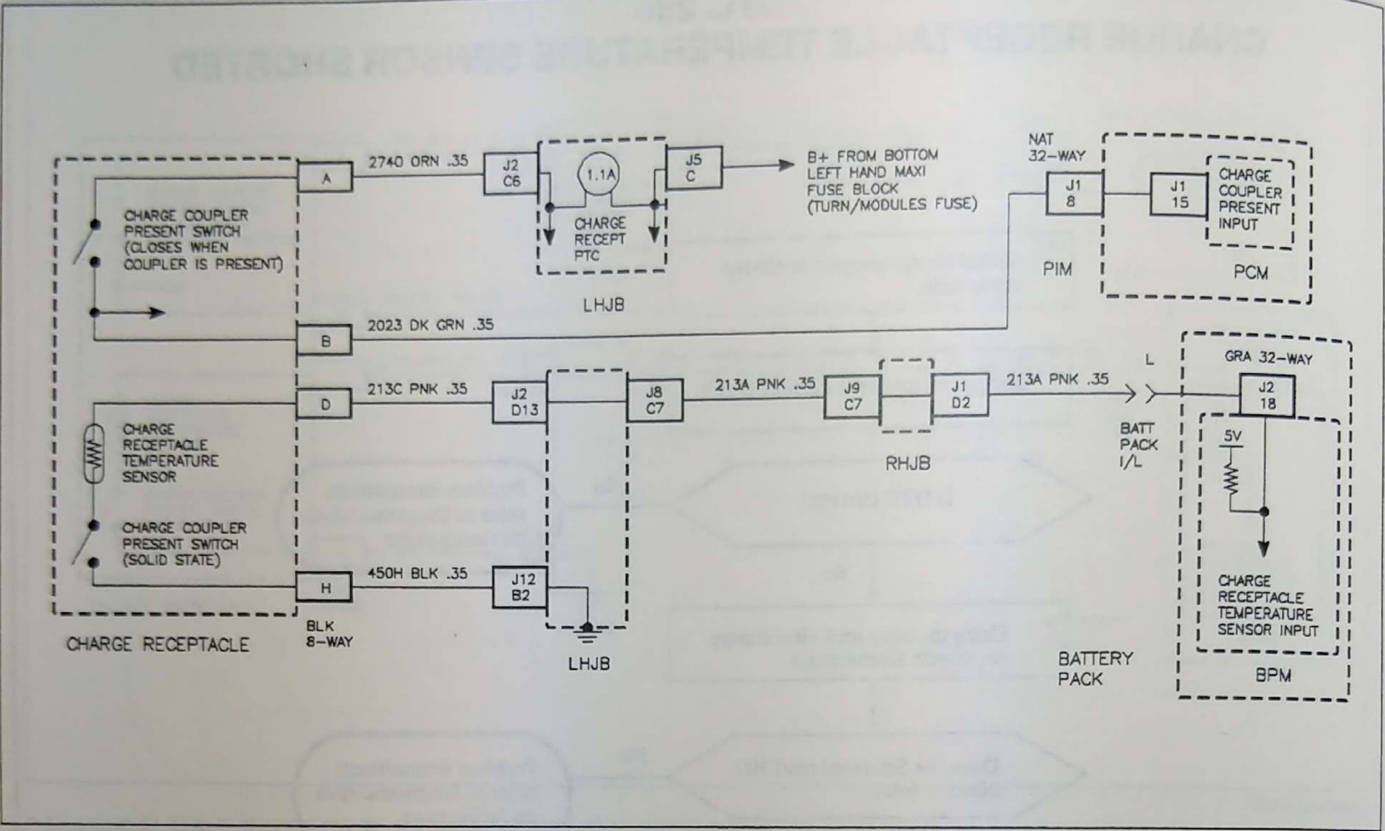
DTC 286
CHARGE RECEPTACLE TEMPERATURE SENSOR SHORTED


Install charge coupler in charge receptacle.
Using Scan tool view current DTCs.
Is DTC current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Using the Scan tool, view charge receptacle temperature.
Does the Scan tool read 300 ohms or less?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Disconnect the battery pack inline 14-way connector.
Does the Scan tool still read 300 ohms or less?
Yes
Internal battery pack wiring or BPM.
No
Disconnect the charge receptacle 8-way connector.
Measure resistance between pins D and H of charge port connector.*
Is resistance 300 ohms or less?
Yes
Charge receptacle.
No
Circuit 213 shorted to ground or 450.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

***IMPORTANT** Make sure charge coupler is installed during this step.

DTC 287 – CHARGE COUPLER CORRELATION FAULT DETECTED


2740 ORN .35
J2 C6
1.1A
J5 C
B+ FROM BOTTOM LEFT HAND MAXI FUSE BLOCK (TURN/MODULES FUSE)
NAT 32–WAY
J1 8
J1 15
CHARGE COUPLER PRESENT INPUT
A
CHARGE COUPLER PRESENT SWITCH (CLOSES WHEN COUPLER IS PRESENT)
CHARGE RECEPT PTC
LHJB
PIM
PCM
B
2023 DK GRN .35
L
GRA 32–WAY
D
213C PNK .35
J2 D13
J8 C7
213A PNK .35
J9 C7
J1 D2
213A PNK .35
J2 18
BATT PACK I/L
5V
CHARGE RECEPTACLE TEMPERATURE SENSOR
RHJB
CHARGE COUPLER PRESENT SWITCH (SOLID STATE)
450H BLK .35
H
J12 B2
CHARGE RECEPTACLE TEMPERATURE SENSOR INPUT
BLK 8–WAY
CHARGE RECEPTACLE
LHJB
BATTERY PACK
BPM

PSMELC68199AA

CHARGE COUPLER CORRELATION FAULT DETECTED

The battery pack module (BPM) uses the temperature sensor circuit for detecting that the charge coupler is present. This is accomplished by the coupler insertion into the charge receptacle which completes the temperature sensor circuit allowing BPM to read the charge receptacle temperature. The propulsion control module (PCM) also detects charge coupler present via a microswitch located in the charge receptacle. The PCM uses this information to prevent shifting out of park while the vehicle is charging.

DTC PARAMETERS

The DTC will set anytime the BPM and PCM disagree that the change coupler is present for 10 seconds.

ACTION TAKEN

The DTC is set and the SERVICE SOON telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 97

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

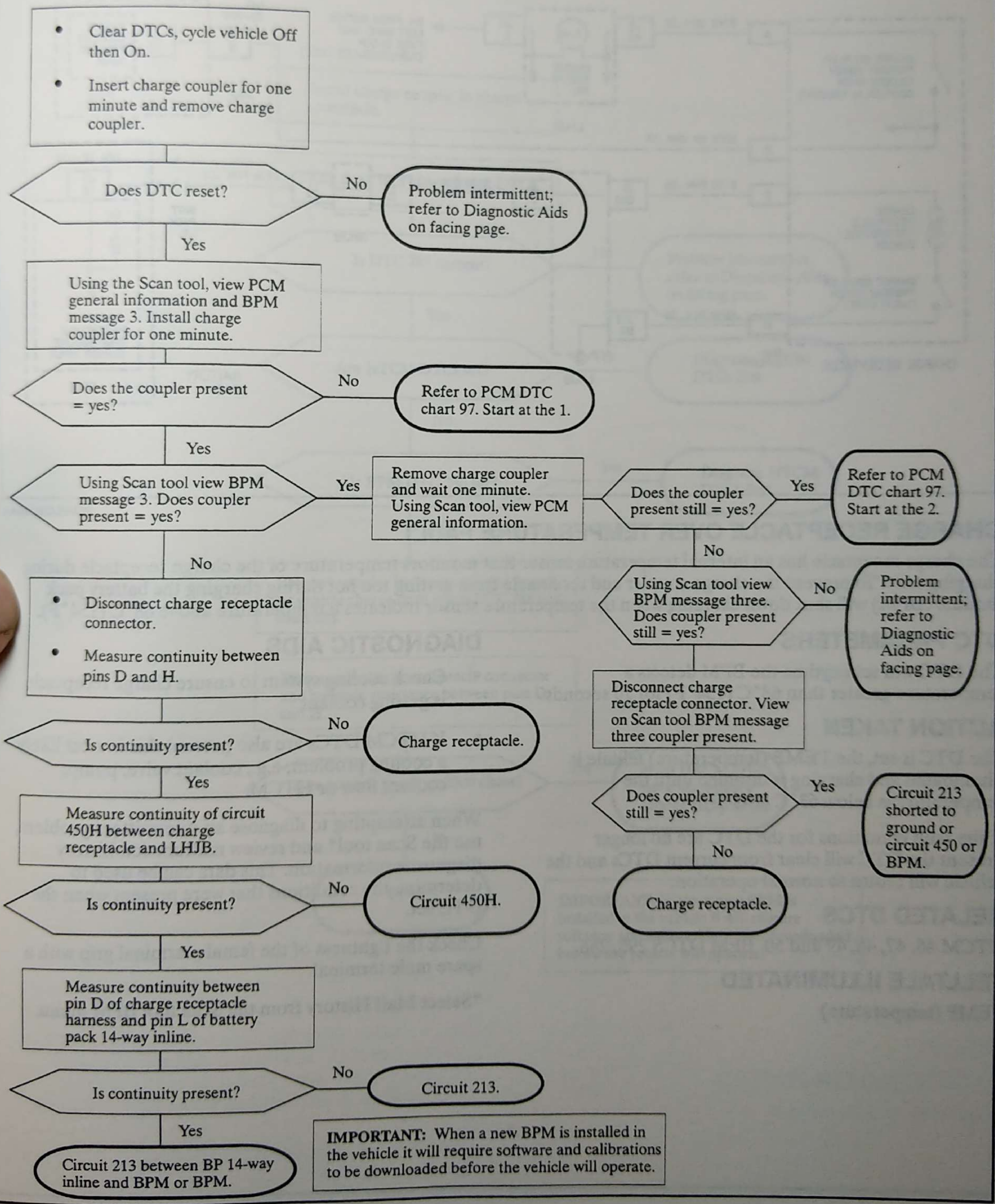
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

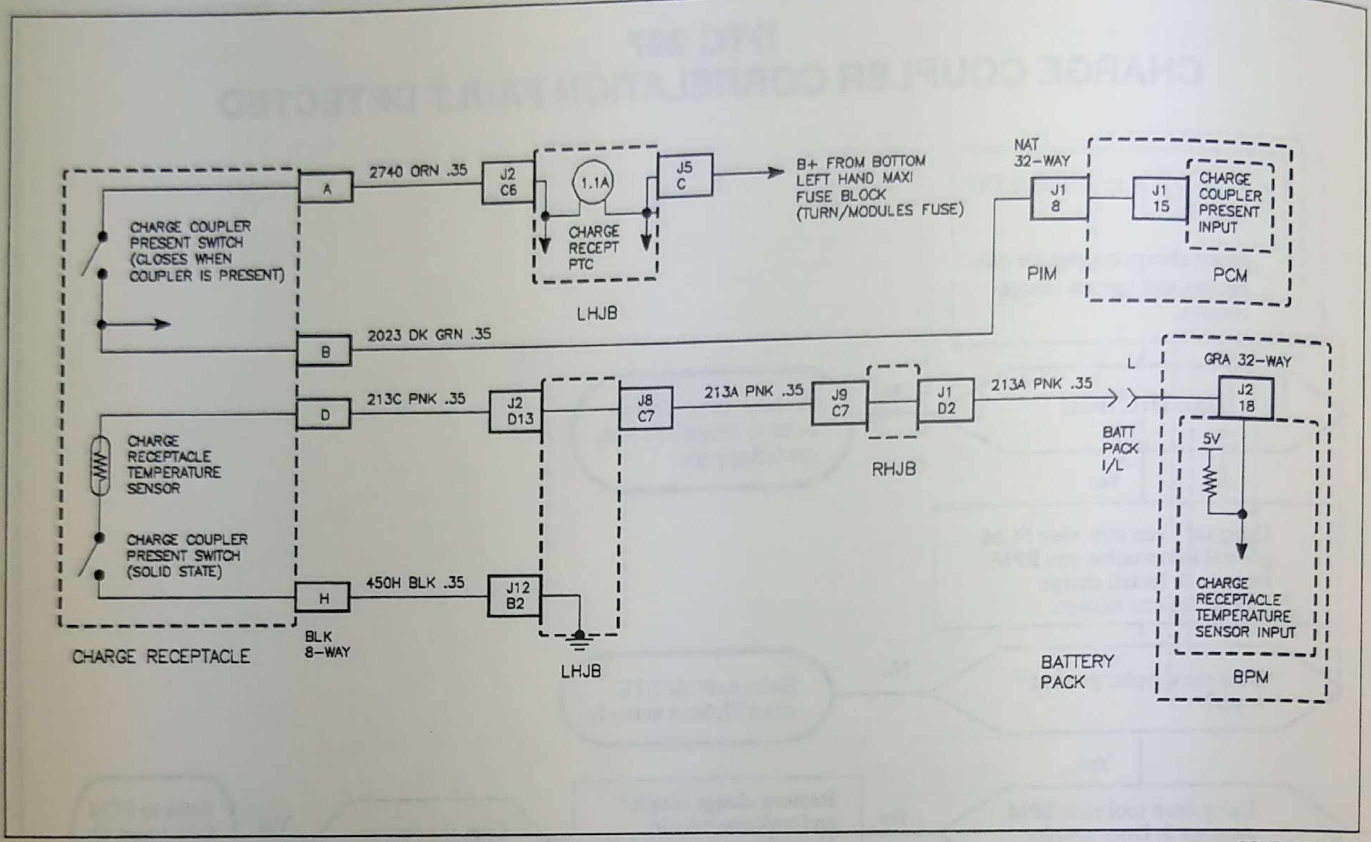
CS CamScanner

DTC 287
CHARGE COUPLER CORRELATION FAULT DETECTED


• Clear DTCs, cycle vehicle Off then On.
• Insert charge coupler for one minute and remove charge coupler.
Does DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Using the Scan tool, view PCM general information and BPM message 3. Install charge coupler for one minute.
Does the coupler present = yes?
No
Refer to PCM DTC chart 97. Start at the 1.
Yes
Using Scan tool view BPM message 3. Does coupler present = yes?
Yes
Remove charge coupler and wait one minute. Using Scan tool, view PCM general information.
Does the coupler present still = yes?
Yes
Refer to PCM DTC chart 97. Start at the 2.
No
Using Scan tool view BPM message three. Does coupler present still = yes?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Disconnect charge receptacle connector. View on Scan tool BPM message three coupler present.
Does coupler present still = yes?
Yes
Circuit 213 shorted to ground or circuit 450 or BPM.
No
Charge receptacle.
No
• Disconnect charge receptacle connector.
• Measure continuity between pins D and H.
Is continuity present?
No
Charge receptacle.
Yes
Measure continuity of circuit 450H between charge receptacle and LHJB.
Is continuity present?
No
Circuit 450H.
Yes
Measure continuity between pin D of charge receptacle harness and pin L of battery pack 14-way inline.
Is continuity present?
No
Circuit 213.
Yes
Circuit 213 between BP 14-way inline and BPM or BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 288 – CHARGE RECEPTACLE OVER TEMPERATURE FAULT


2740 ORN .35
A
J2 C6
1.1A
J5 C
B+ FROM BOTTOM LEFT HAND MAXI FUSE BLOCK (TURN/MODULES FUSE)
NAT 32-WAY
J1 8
J1 15
CHARGE COUPLER PRESENT INPUT
PIM
PCM
CHARGE COUPLER PRESENT SWITCH (CLOSES WHEN COUPLER IS PRESENT)
CHARGE RECEPT PTC
LHJB
2023 DK GRN .35
B
L
GRA 32-WAY
J2 18
D
213C PNK .35
J2 D13
J8 C7
213A PNK .35
J9 C7
J1 D2
213A PNK .35
BATT PACK I/L
5V
RHJB
CHARGE RECEPTACLE TEMPERATURE SENSOR
CHARGE COUPLER PRESENT SWITCH (SOLID STATE)
450H BLK .35
H
J12 B2
CHARGE RECEPTACLE TEMPERATURE SENSOR INPUT
BLK 8-WAY
CHARGE RECEPTACLE
LHJB
BATTERY PACK
BPM

PSMELC68199AA

CHARGE RECEPTACLE OVER TEMPERATURE FAULT

The charge receptacle has an internal temperature sensor that monitors temperature of the charge receptacle during charging only. To prevent the charge coupler and receptacle from getting too hot during charging the battery pack module (BPM) will shut down charging when the temperature sensor indicates a temperature above 68°C (154°F).

DTC PARAMETERS

The DTC will set anytime the BPM detects a temperature greater than 68°C (154°F) for 10 seconds.

ACTION TAKEN

The DTC is set, the TEMP (temperature) telltale is illuminated and charging is disabled until the temperature is below 63°C (145°F).

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

HTCM 46, 47, 48, 49 and 50, BPM DTCS 296, 286.

TELLTALE ILLUMINATED

TEMP (temperature)

DIAGNOSTIC AIDS

- Check cooling system to ensure charge receptacle is getting coolant.
- If HTCM DTCs are also present this is most likely a cooling problem; e.g., coolant valve, pump, coolant flow or HTCM.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

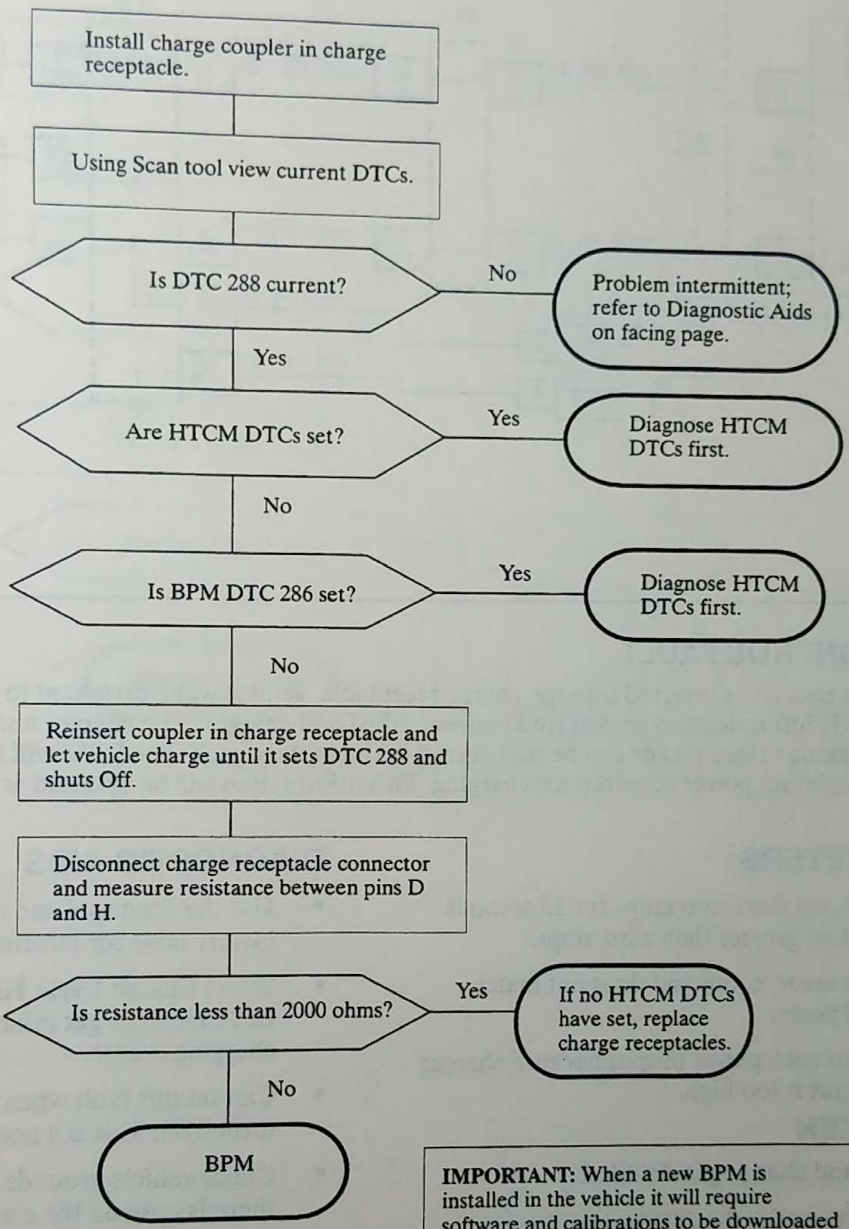
Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

CS CamScanner

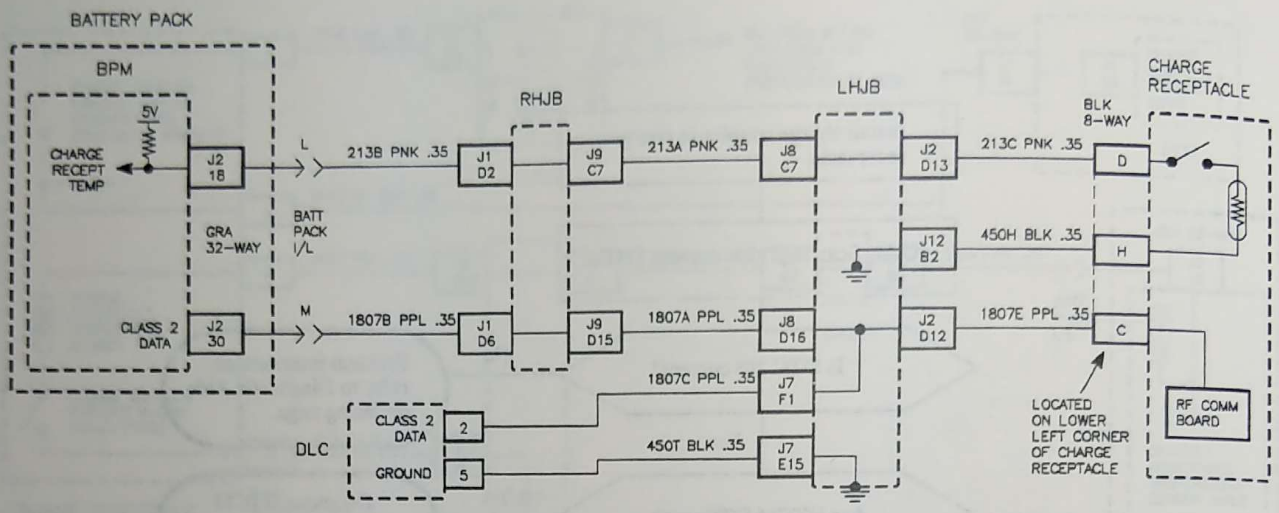
DTC 288

CHARGE RECEPTACLE OVER TEMPERATURE FAULT


Install charge coupler in charge receptacle.
Using Scan tool view current DTCs.
Is DTC 288 current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are HTCM DTCs set?
Yes
Diagnose HTCM DTCs first.
No
Is BPM DTC 286 set?
Yes
Diagnose HTCM DTCs first.
No
Reinsert coupler in charge receptacle and let vehicle charge until it sets DTC 288 and shuts Off.
Disconnect charge receptacle connector and measure resistance between pins D and H.
Is resistance less than 2000 ohms?
Yes
If no HTCM DTCs have set, replace charge receptacles.
No
BPM

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 289 – CHARGE CONTROL FAULT


BATTERY PACK
BPM
5V
CHARGE RECEPT TEMP
J2 18
GRA 32–WAY
CLASS 2 DATA
J2 30
L
BATT PACK I/L
M
213B PNK .35
1807B PPL .35
RHJB
J1 D2
J1 D6
J9 C7
J9 D15
213A PNK .35
1807A PPL .35
1807C PPL .35
450T BLK .35
DLC
CLASS 2 DATA
2
GROUND
5
LHJB
J8 C7
J8 D16
J7 F1
J7 E15
J2 D13
J12 B2
J2 D12
213C PNK .35
450H BLK .35
1807E PPL .35
BLK 8–WAY
D
H
C
LOCATED ON LOWER LEFT CORNER OF CHARGE RECEPTACLE
CHARGE RECEPTACLE
RF COMM BOARD

PSMELC68205AA

CHARGE CONTROL FAULT

When the charge coupler is inserted into the charge receptacle, vehicle wake-up is sent to the battery pack module (BPM) and class II information is transferred between BPM and charger. The charger and BPM initialize and transfer system status before power can be transferred to the battery pack. The BPM will then send to the charger a percentage of maximum power required for charging. This information will be updated as the vehicle charges to complete.

DTC PARAMETERS

- Pack current less than zero amps for 15 seconds after requesting greater than zero amps.
- Pack current error, command does not match actual at full power.
- BPM requests zero power output because charger minimal output is too high.

ACTION TAKEN

The DTC is set and charging is disabled.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 295

TELLTALE ILLUMINATED

None displayed on charger.

DIAGNOSTIC AIDS

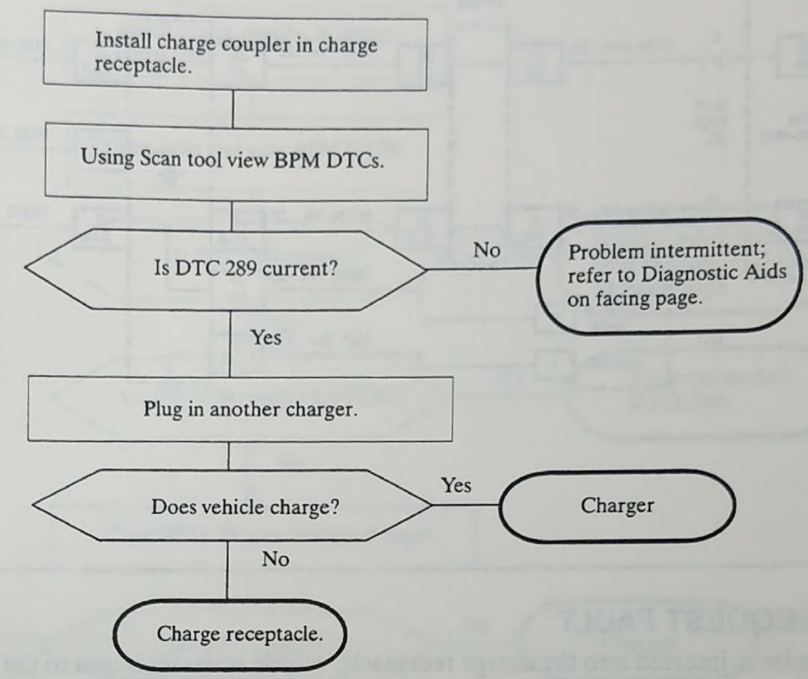
- Use the Scan tool and review the charge event history table for information on the charging event.
- Select Charge Event History from the Scan tool BPM menu to get information on the last four charging events.
- Can set this fault when using a CCM with all loads turned on. This is a normal condition.
- Check vehicle grounds. This DTC can be set if there is nose on the class II line.
- Find out if customer was using CCM, wall or floor charger. If failed using one charger and the other charger worked charger requires service.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

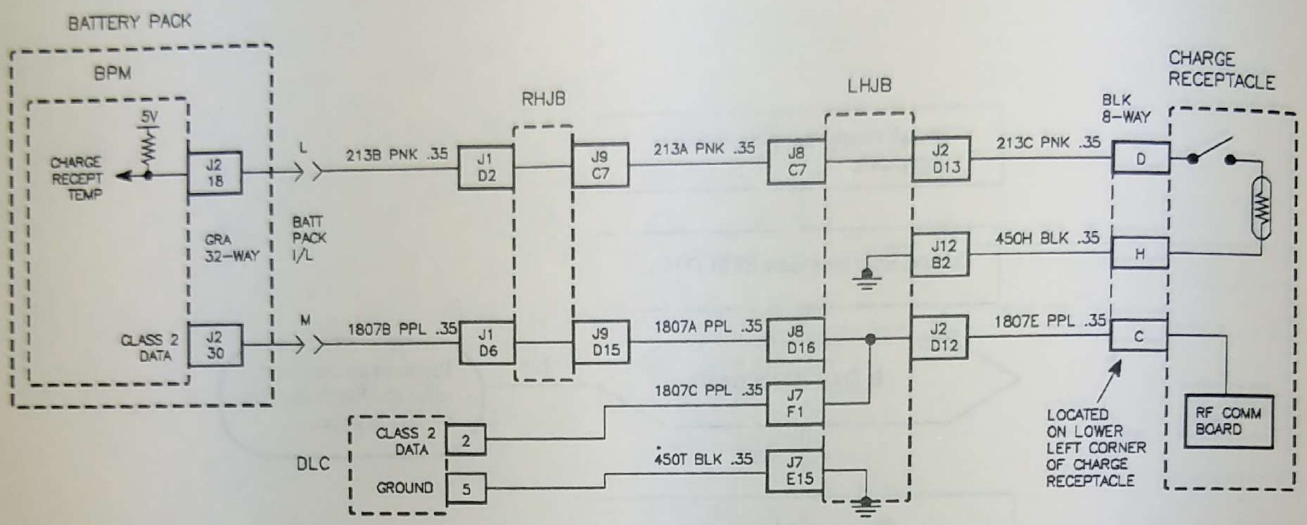
Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

DTC 289
CHARGE CONTROL FAULT


Install charge coupler in charge receptacle.
Using Scan tool view BPM DTCs.
Is DTC 289 current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Plug in another charger.
Does vehicle charge?
Yes
Charger
No
Charge receptacle.

DTC 290 – ZERO POWER REQUEST FAULT


BATTERY PACK
BPM
5V
CHARGE RECEPT TEMP
J2 18
GRA 32–WAY
CLASS 2 DATA
J2 30
L
M
BATT PACK I/L
213B PNK .35
1807B PPL .35
RHJB
J1 D2
J1 D6
J9 C7
J9 D15
213A PNK .35
1807A PPL .35
1807C PPL .35
450T BLK .35
LHJB
J8 C7
J8 D16
J7 F1
J7 E15
J2 D13
J12 B2
J2 D12
213C PNK .35
450H BLK .35
1807E PPL .35
BLK 8–WAY
D
H
C
CHARGE RECEPTACLE
RF COMM BOARD
LOCATED ON LOWER LEFT CORNER OF CHARGE RECEPTACLE
DLC
CLASS 2 DATA
GROUND
2
5

PSMELC68205AA

ZERO POWER REQUEST FAULT

When the charge coupler is inserted into the charge receptacle, vehicle wake-up is sent to the battery pack module (BPM) and class II information is transferred between BPM and charger. The charger and BPM initialize and transfer system status before power can be transferred to the battery pack. The BPM will then send to the charger a percentage of maximum power required for charging. This information will be updated as the vehicle charges to complete.

DTC PARAMETERS

BPM requests zero power output because charger minimal output is too high.

This DTC will set anytime the charger current exceeds the BPM commanded current.

ACTION TAKEN

The DTC is set, the BPM commands current to zero. BPM will then cycle back On to finish charge. If minimum charger output is still to high the BPM will continue to cycle the charger On and Off.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 295, module DTCs

TELLTALE ILLUMINATED

None. Check vehicle on charger.

DIAGNOSTIC AIDS

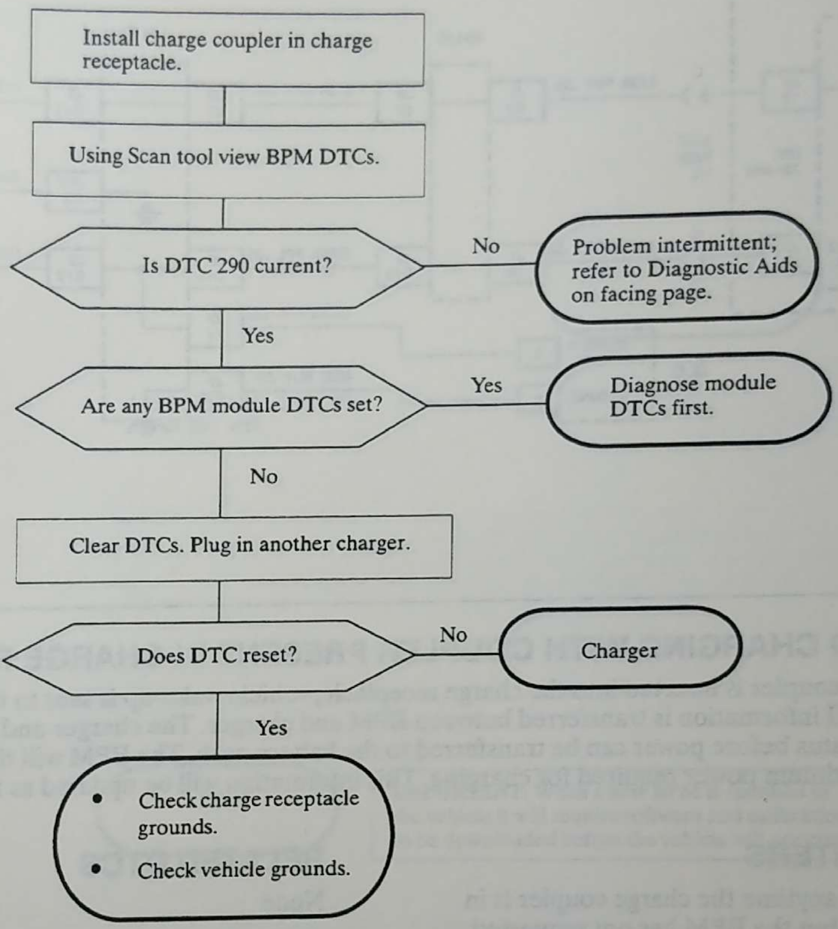
- Use the Scan tool and review the charge event history table for information on the charging event.
- This DTC may set if the charger is malfunctioning or there is a low capacity module(s) in the BP.
- Check vehicle grounds. This DTC can set if there is noise on the class II line.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

DTC 290
ZERO POWER REQUEST FAULT


Install charge coupler in charge receptacle.
Using Scan tool view BPM DTCs.
Is DTC 290 current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any BPM module DTCs set?
Yes
Diagnose module DTCs first.
No
Clear DTCs. Plug in another charger.
Does DTC reset?
No
Charger
Yes
• Check charge receptacle grounds.
• Check vehicle grounds.

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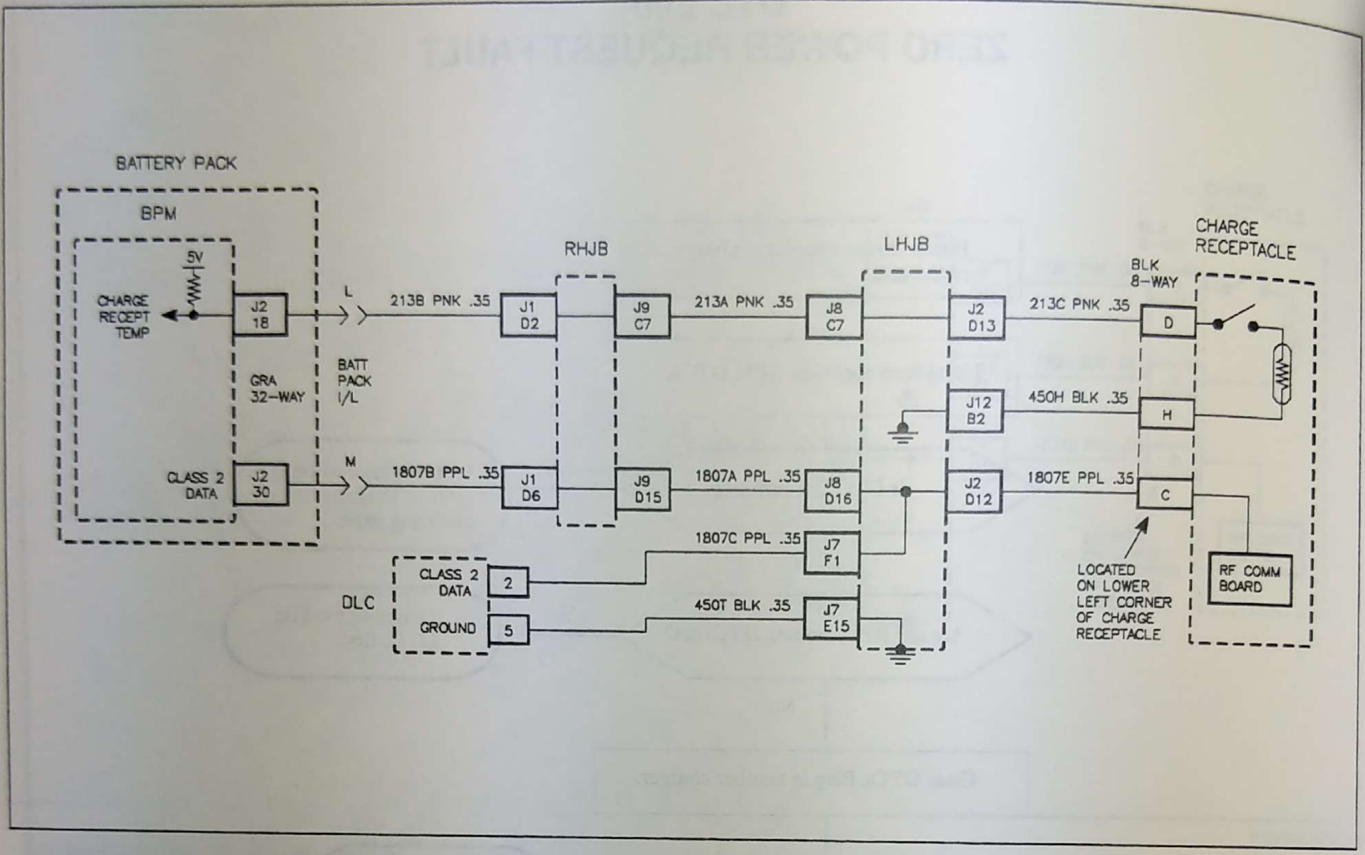
DTC 291 – UNINTENDED CHARGING WITH COUPLER PRESENT IN CHARGE RECEPTACLE


BATTERY PACK
BPM
5V
CHARGE RECEPT TEMP
J2 18
GRA 32-WAY
CLASS 2 DATA
J2 30
L
M
BATT PACK I/L
213B PNK .35
1807B PPL .35
RHJB
J1 D2
J1 D6
J9 C7
J9 D15
213A PNK .35
1807A PPL .35
1807C PPL .35
450T BLK .35
J8 C7
J8 D16
J7 F1
J7 E15
DLC
CLASS 2 DATA
2
GROUND
5
LHJB
J2 D13
J12 B2
J2 D12
213C PNK .35
450H BLK .35
1807E PPL .35
BLK 8-WAY
D
H
C
CHARGE RECEPTACLE
LOCATED ON LOWER LEFT CORNER OF CHARGE RECEPTACLE
RF COMM BOARD

PSMELC68205AA

UNINTENDED CHARGING WITH COUPLER PRESENT IN CHARGE RECEPTACLE

When the charge coupler is inserted into the charge receptacle, vehicle wake-up is sent to the battery pack module (BPM) and class II information is transferred between BPM and charger. The charger and BPM initialize and transfer system status before power can be transferred to the battery pack. The BPM will then send to the charger a percentage of maximum power required for charging. This information will be updated as the vehicle charges to complete.

DTC PARAMETERS

This DTC will set anytime the charge coupler is in charge receptacle but the BPM has not requested charger output and is receiving current above five amps for five seconds.

ACTION TAKEN

The DTC is set, the SERVICE SOON telltale is illuminated, charging is disabled and the auto disconnect relays are commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

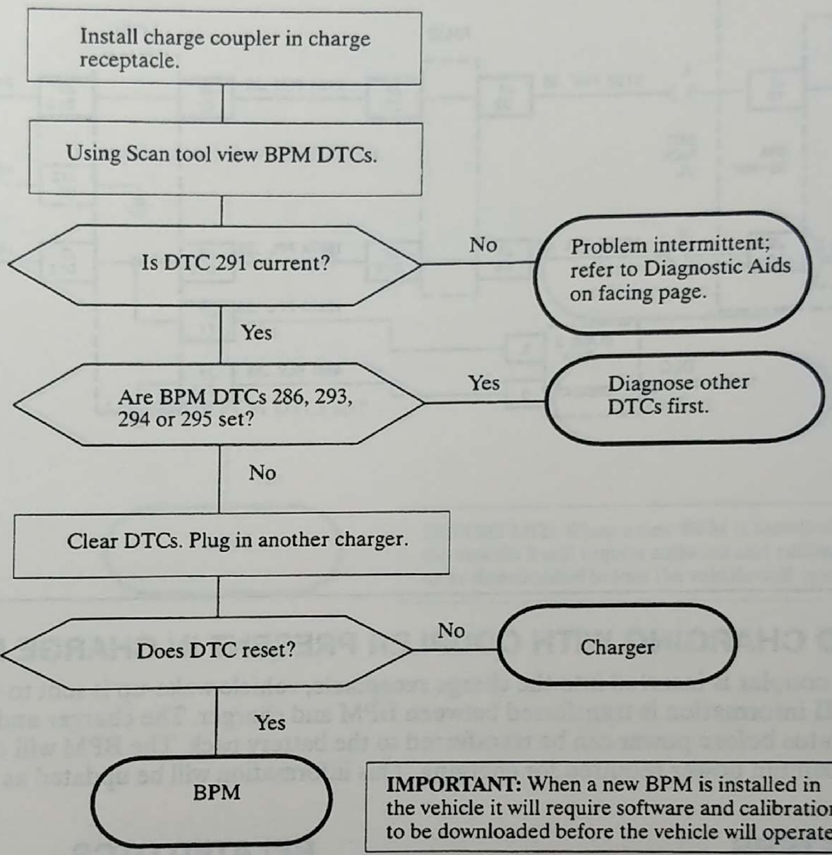
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

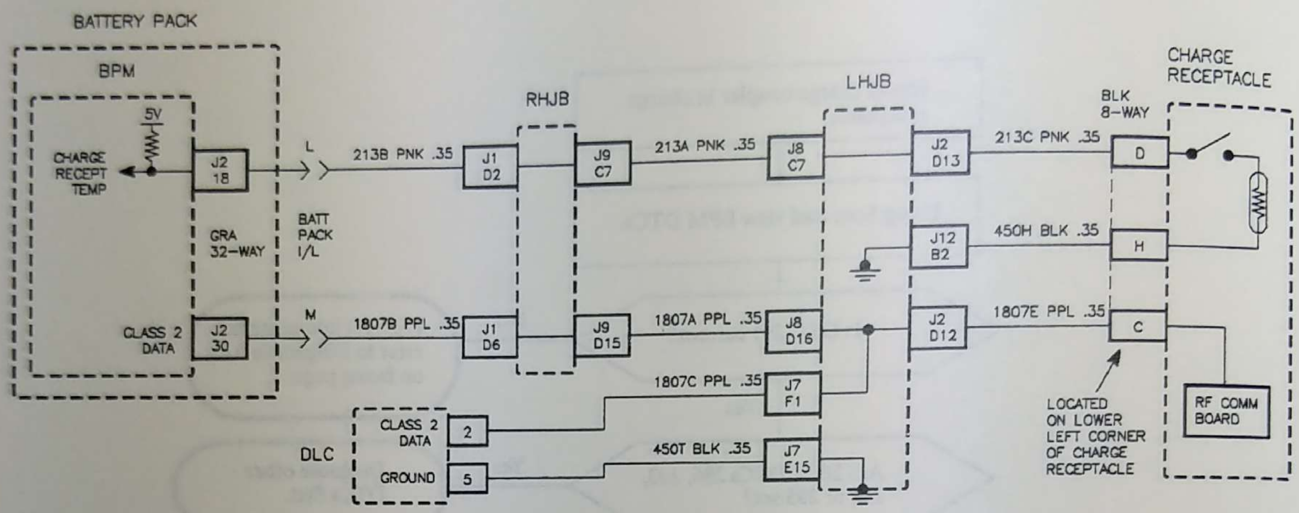
CS CamScanner

DTC 291
UNINTENDED CHARGING WITH COUPLER PRESENT IN CHARGE RECEPTACLE


Install charge coupler in charge receptacle.
Using Scan tool view BPM DTCs.
Is DTC 291 current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are BPM DTCs 286, 293, 294 or 295 set?
Yes
Diagnose other DTCs first.
No
Clear DTCs. Plug in another charger.
Does DTC reset?
No
Charger
Yes
BPM

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 292 – UNINTENDED CHARGING WITHOUT COUPLER PRESENT IN CHARGE RECEPTACLE


BATTERY PACK
BPM
5V
CHARGE RECEPT TEMP
J2 18
GRA 32–WAY
CLASS 2 DATA
J2 30
L
M
BATT PACK I/L
213B PNK .35
1807B PPL .35
RHJB
J1 D2
J1 D6
J9 C7
J9 D15
213A PNK .35
1807A PPL .35
1807C PPL .35
450T BLK .35
DLC
CLASS 2 DATA
GROUND
2
5
LHJB
J8 C7
J8 D16
J7 F1
J7 E15
J2 D13
J12 B2
J2 D12
213C PNK .35
450H BLK .35
1807E PPL .35
BLK 8–WAY
D
H
C
CHARGE RECEPTACLE
RF COMM BOARD
LOCATED ON LOWER LEFT CORNER OF CHARGE RECEPTACLE

PSMELC68205AA

UNINTENDED CHARGING WITH COUPLER PRESENT IN CHARGE RECEPTACLE

When the charge coupler is inserted into the charge receptacle, vehicle wake-up is sent to the battery pack module (BPM) and class II information is transferred between BPM and charger. The charger and BPM initialize and transfer system status before power can be transferred to the battery pack. The BPM will then send to the charger a percentage of maximum power required for charging. This information will be updated as the vehicle charges to complete.

DTC PARAMETERS

This DTC will set anytime the charge coupler is not present in charge receptacle, vehicle in park, but BPM sees current at charge receptacle:

After 60 seconds ➡ −20 to 40°C (−4 to 104°F) < 30 amps
➡ 45°C (113°F) = 15 amps
➡ 50°C (122°F) = 5 amps

ACTION TAKEN

The DTC is set, the SERVICE SOON telltale is illuminated, charging is disabled and the auto disconnect relays are commanded open.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

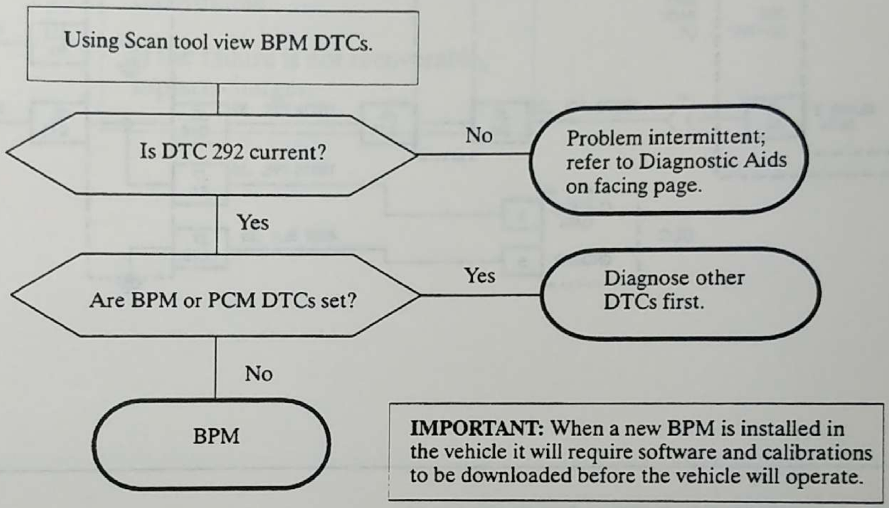
This DTC can set if an attempt is made to put current into the pack by an outside source.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

DTC 292
UNINTENDED CHARGING WITHOUT COUPLER PRESENT IN CHARGE RECEPTACLE


Using Scan tool view BPM DTCs.
Is DTC 292 current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are BPM or PCM DTCs set?
Yes
Diagnose other DTCs first.
No
BPM

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

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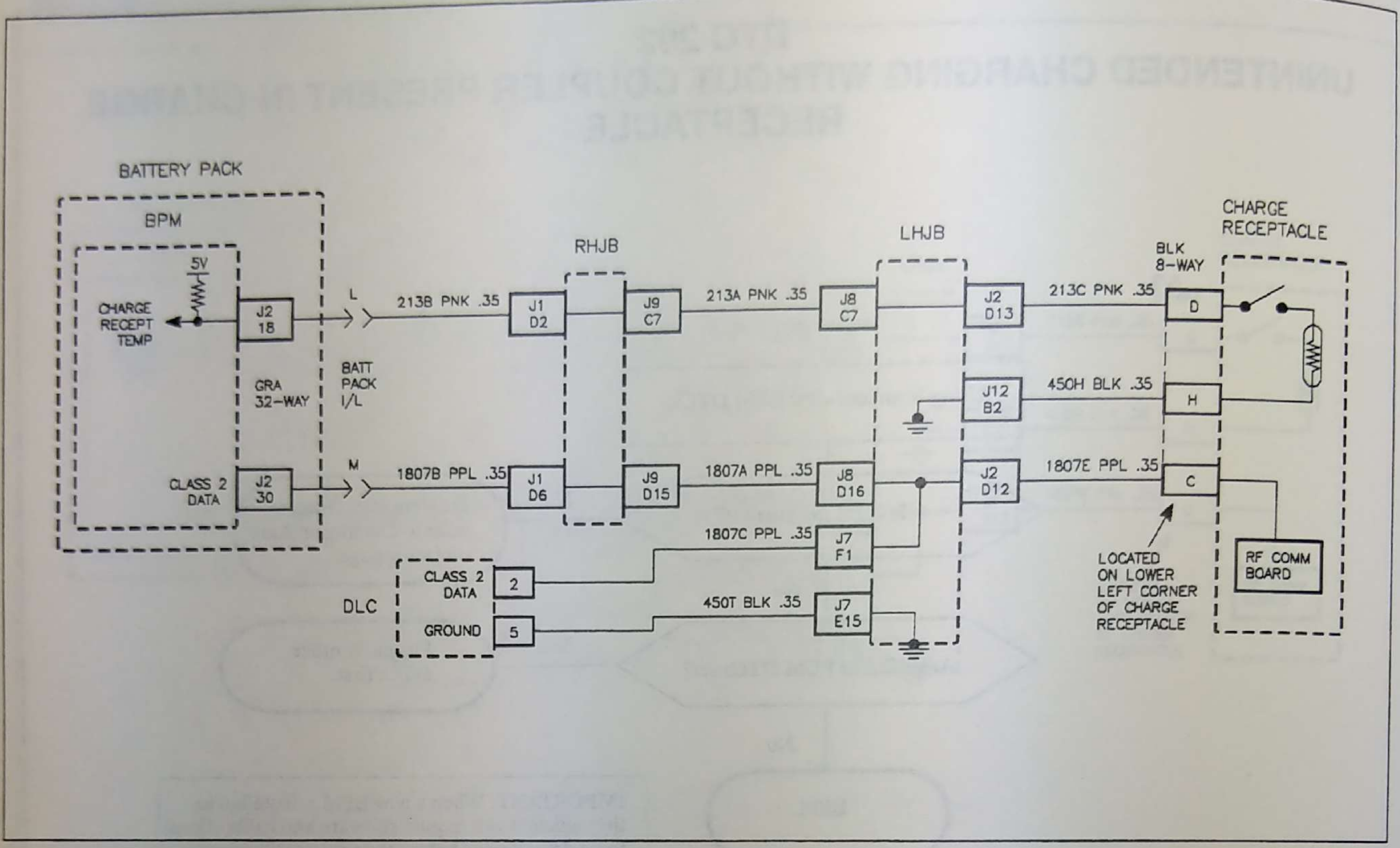
DTC 293 – CHARGER HARDWARE FAILURE FAULT


BATTERY PACK
BPM
5V
CHARGE RECEPT TEMP
J2 18
GRA 32–WAY
CLASS 2 DATA
J2 30
L
M
BATT PACK I/L
213B PNK .35
1807B PPL .35
J1 D2
J1 D6
RHJB
J9 C7
J9 D15
213A PNK .35
1807A PPL .35
1807C PPL .35
450T BLK .35
J8 C7
J8 D16
J7 F1
J7 E15
DLC
CLASS 2 DATA
2
GROUND
5
LHJB
J2 D13
J12 B2
J2 D12
213C PNK .35
450H BLK .35
1807E PPL .35
BLK 8–WAY
CHARGE RECEPTACLE
D
H
C
LOCATED ON LOWER LEFT CORNER OF CHARGE RECEPTACLE
RF COMM BOARD

PSMELC68205AA

CHARGER HARDWARE FAILURE FAULT

When the charge coupler is inserted into the charge receptacle, vehicle wake-up is sent to the battery pack module (BPM) and class II information is transferred between BPM and charger. The charger and BPM initialize and transfer system status before power can be transferred to the battery pack. The BPM will then send to the charger a percentage of maximum power required for charging. This information will be updated as the vehicle charges to complete.

DTC PARAMETERS

This DTC will set anytime the charger reports over class II to the BPM that it has a hardware failure.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

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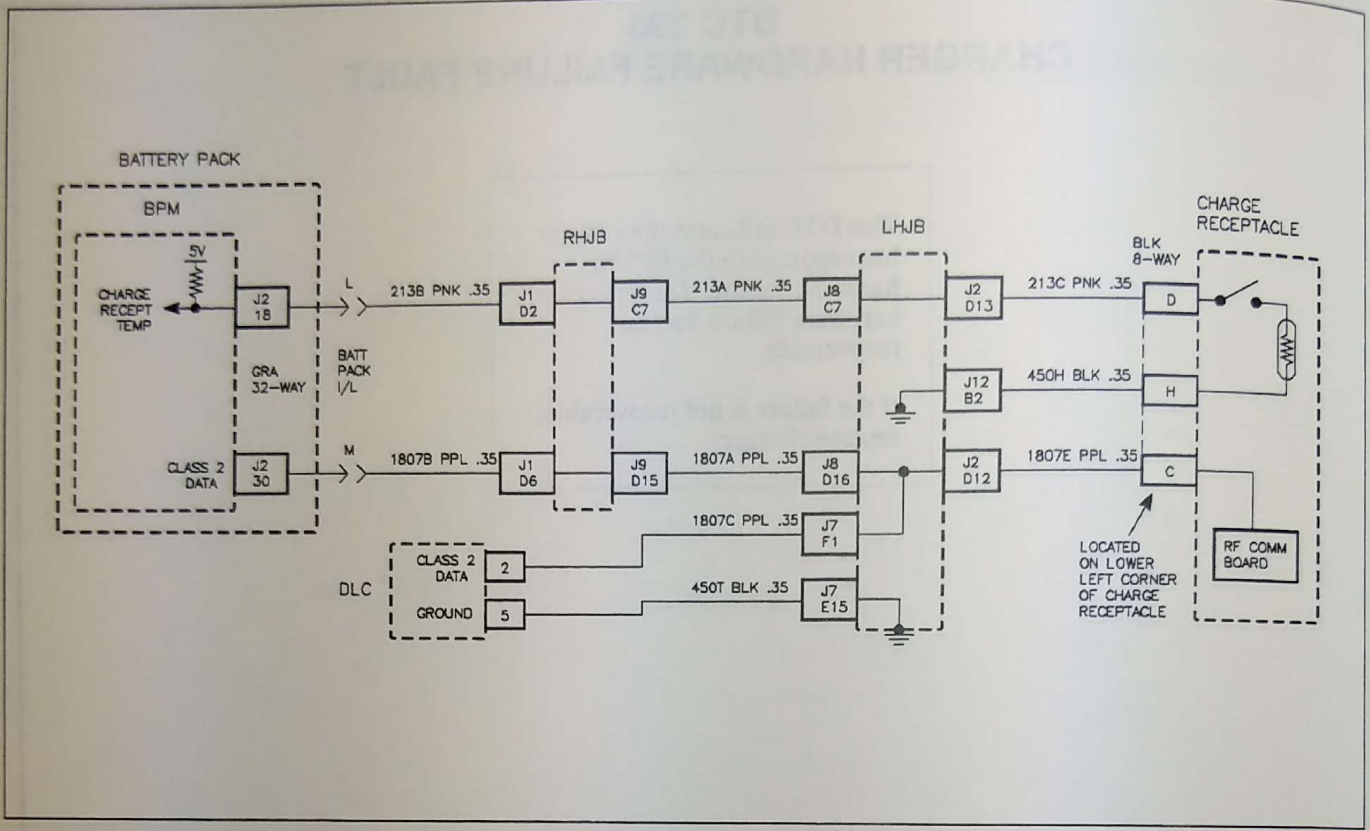
DTC 293
CHARGER HARDWARE FAILURE FAULT

This DTC indicates the charger has reported to the BPM a hardware failure. This charger hardware failure may be recoverable.

If the failure is not recoverable, replace charger.

DTC 294 – CHARGER COMMUNICATION FAULT


BATTERY PACK
BPM
5V
CHARGE RECEPT TEMP
J2 18
GRA 32-WAY
CLASS 2 DATA
J2 30
L
BATT PACK I/L
M
213B PNK .35
1807B PPL .35
RHJB
J1 D2
J1 D6
J9 C7
J9 D15
213A PNK .35
1807A PPL .35
1807C PPL .35
450T BLK .35
DLC
CLASS 2 DATA
2
GROUND
5
LHJB
J8 C7
J8 D16
J7 F1
J7 E15
J2 D13
J12 B2
J2 D12
213C PNK .35
450H BLK .35
1807E PPL .35
BLK 8-WAY
D
H
C
LOCATED ON LOWER LEFT CORNER OF CHARGE RECEPTACLE
CHARGE RECEPTACLE
RF COMM BOARD

PSMELC68205AA

CHARGER COMMUNICATION FAULT

When the charge coupler is inserted into the charge receptacle, vehicle wake-up is sent to the battery pack module (BPM) and class II information is transferred between BPM and charger. The charger and BPM initialize and transfer system status before power can be transferred to the battery pack. The BPM will then send to the charger a percentage of maximum power required for charging. This information will be updated as the vehicle charges to complete.

DTC PARAMETERS

This DTC will set anytime the charger has three occurrences of not receiving a certain BPM message for 250 milliseconds.

ACTION TAKEN

The DTC is set and the charger will display check charger.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

Check the tightness of the female terminal grip with a spare male terminal.

An intermittent problem could be caused by a charger or charge receptacle. Try charging with a different charger.

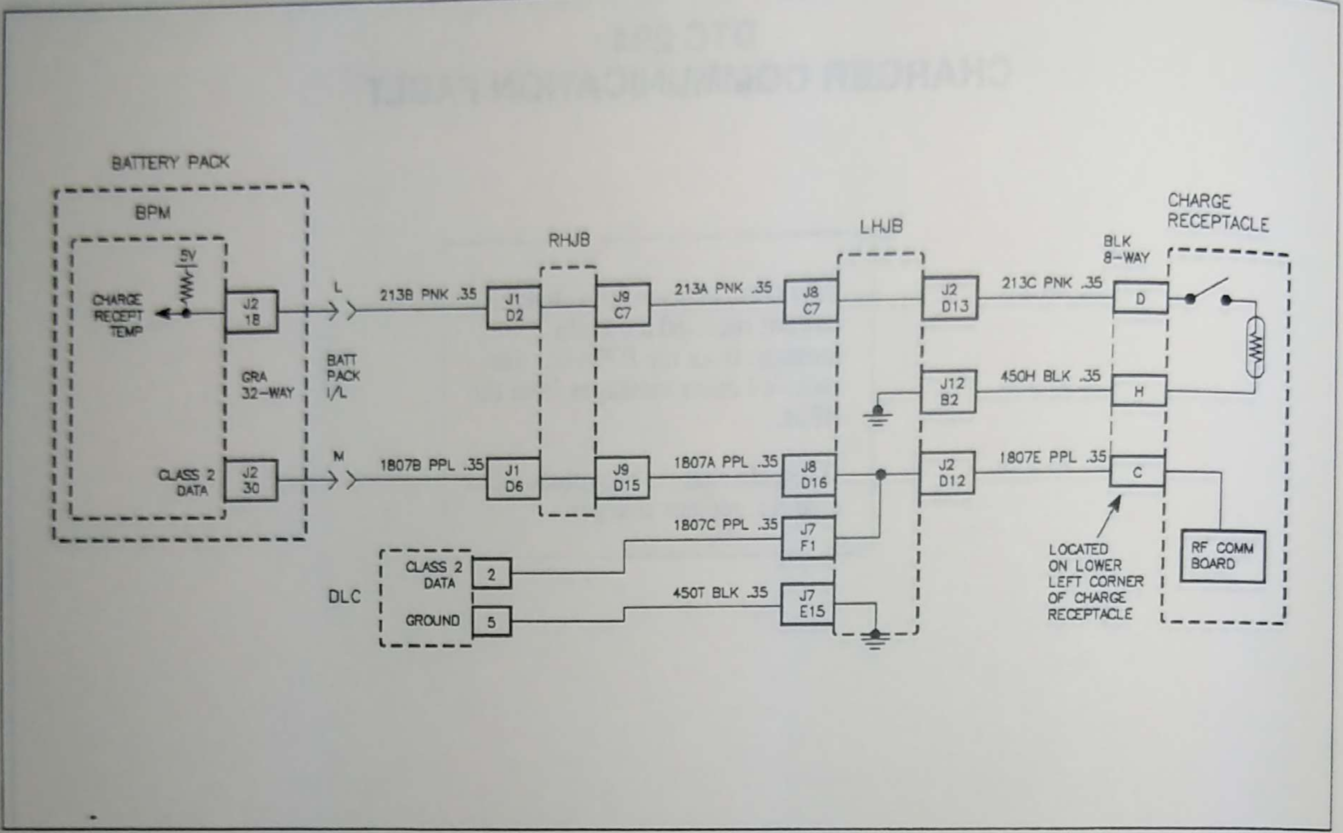
*Select Malf History from the Scan tool BPM menu.

DTC 294
CHARGER COMMUNICATION FAULT

This DTC indicates the charger has not received a certain message from the BPM but has received other messages from the BPM.

If vehicle charges ok with another charger, replace charger.

DTC 295 – CHARGER COUNT FAULT


BATTERY PACK
BPM
5V
CHARGE RECEPT TEMP
J2 18
GRA 32–WAY
CLASS 2 DATA
J2 30
L
M
BATT PACK I/L
213B PNK .35
1807B PPL .35
RHJB
J1 D2
J1 D6
J9 C7
J9 D15
213A PNK .35
1807A PPL .35
1807C PPL .35
450T BLK .35
DLC
CLASS 2 DATA
2
GROUND
5
LHJB
J8 C7
J8 D16
J7 F1
J7 E15
J2 D13
J12 B2
J2 D12
213C PNK .35
450H BLK .35
1807E PPL .35
BLK 8–WAY
D
H
C
CHARGE RECEPTACLE
RF COMM BOARD
LOCATED ON LOWER LEFT CORNER OF CHARGE RECEPTACLE

PSMELC68205AA

CHARGER COUNT FAULT

When the charge coupler is inserted into the charge receptacle, vehicle wake-up is sent to the battery pack module (BPM) and class II information is transferred between BPM and charger. The charger and BPM initialize and transfer system status before power can be transferred to the battery pack. The BPM will then send to the charger a percentage of maximum power required for charging. This information will be updated as the vehicle charges to complete.

DTC PARAMETERS

This DTC will set anytime BPM has received five charger faults during one charging event.

ACTION TAKEN

The DTC is set, charging will be disabled and the charger will display check charger.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 289 and 290.

TELLTALE ILLUMINATED

None

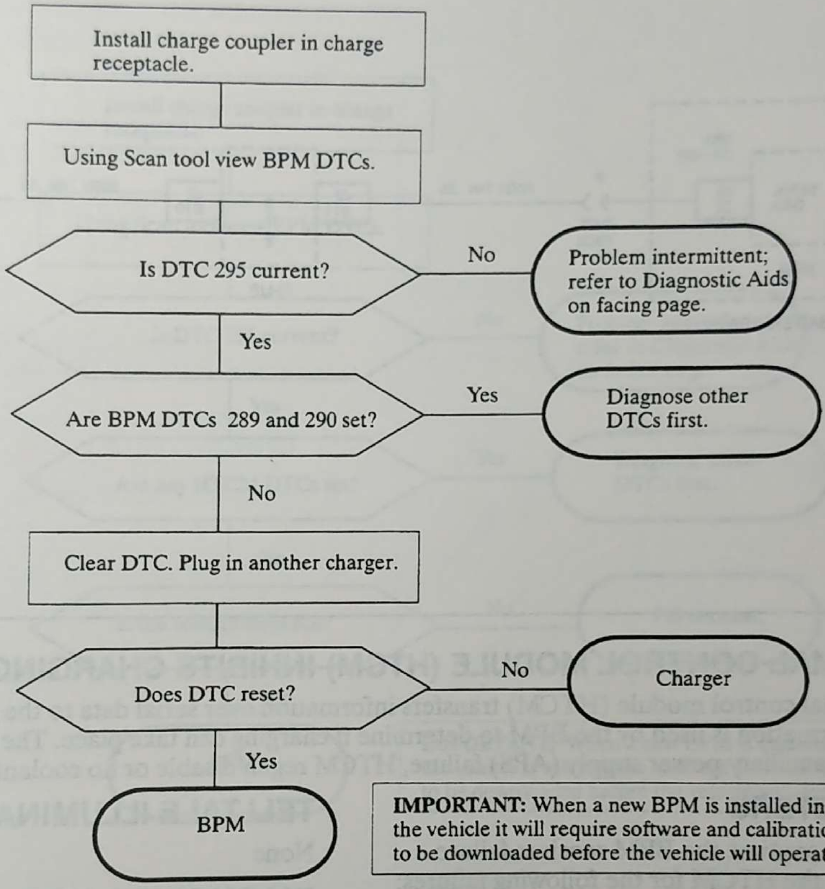
DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

Check the tightness of the female terminal grip with a spare male terminal.

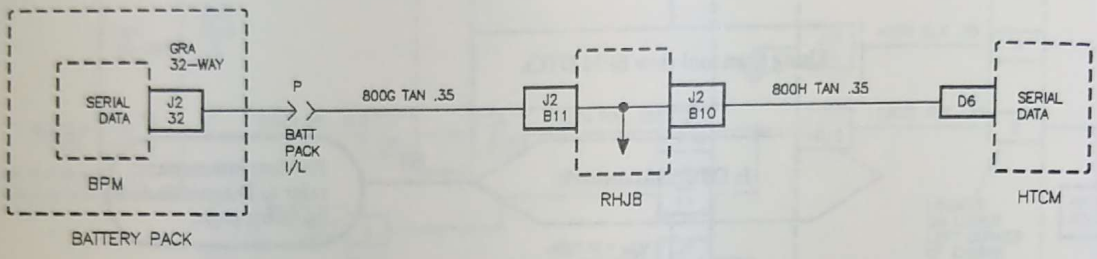
*Select Malf History from the Scan tool BPM menu.

DTC 295
CHARGER COUNT FAULT


Install charge coupler in charge receptacle.
Using Scan tool view BPM DTCs.
Is DTC 295 current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are BPM DTCs 289 and 290 set?
Yes
Diagnose other DTCs first.
No
Clear DTC. Plug in another charger.
Does DTC reset?
No
Charger
Yes
BPM

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 296 – HPVS/THERMAL CONTROL MODULE (HTCM) INHIBITS CHARGING



PSMELC68206AA

HPVS/THERMAL CONTROL MODULE (HTCM) INHIBITS CHARGING

The HPVS/thermal control module (HTCM) transfers information over serial data to the battery pack module (BPM). This information is used by the BPM to determine if charging can take place. The BPM will inhibit charging based on HTCM auxiliary power supply (APS) failure, HTCM regen disable or no coolant present.

DTC PARAMETERS

This DTC will set anytime the BPM receives failure information from the HTCM for the following failures:

- APS (auxiliary power supply)
- HTCM regen charge disabled
- No coolant present

ACTION TAKEN

The DTC is set and charging is disabled.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

HTCM DTCS

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

- If this DTC is set check the coolant level.
- If HTCM DTCs are also set this indicates a cooling or HTCM problem.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

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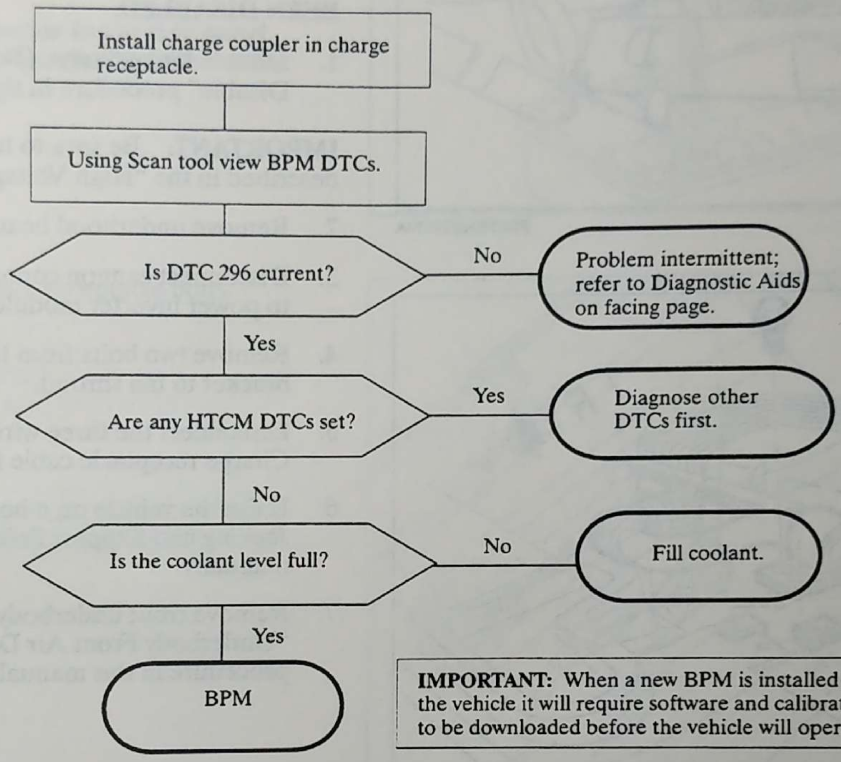
DTC 296
HTCM INHIBITS CHARGING


Install charge coupler in charge receptacle.
Using Scan tool view BPM DTCs.
Is DTC 296 current?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Are any HTCM DTCs set?
Yes
Diagnose other DTCs first.
No
Is the coolant level full?
No
Fill coolant.
Yes
BPM

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

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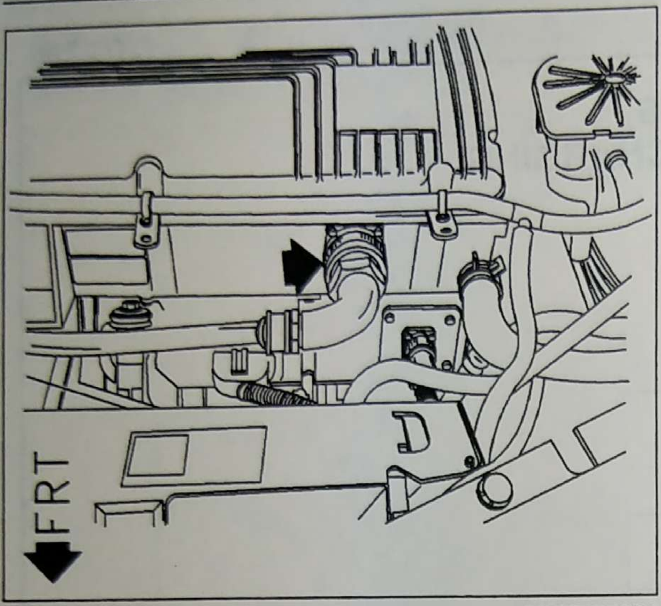
CHARGE RECEPTACLE

REMOVAL



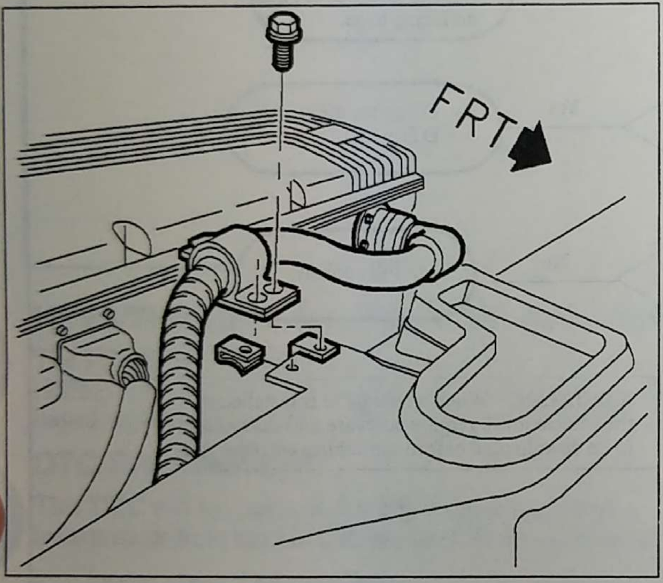
PSMPEN65997AA

CAUTION: **TO REDUCE THE RISK OF SEVERE SHOCKS AND BURNS, THE HIGH VOLTAGE SYSTEM SHOULD BE DISABLED ANY TIME SERVICE WORK IS BEING PERFORMED ON OR AROUND THE HIGH VOLTAGE SYSTEM. WHEN IN DOUBT, ALWAYS DISABLE THE HIGH VOLTAGE SYSTEM. THE 12 VOLT SYSTEM WILL STILL BE ACTIVE AFTER THE HIGH VOLTAGE SYSTEM HAS BEEN DISABLED.**

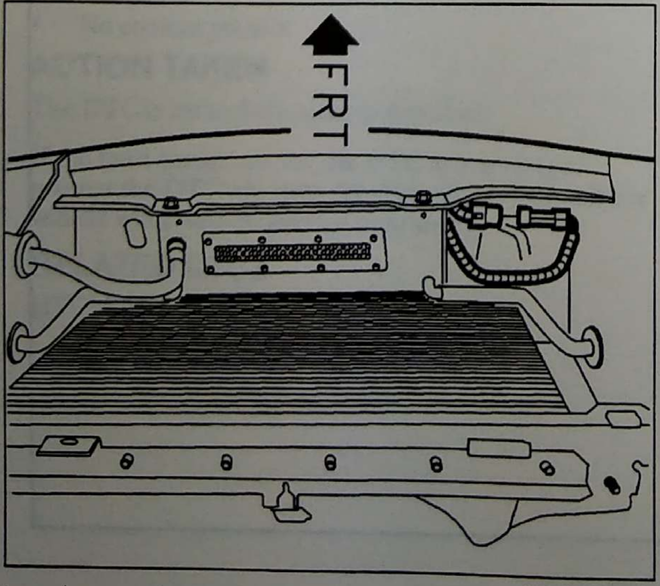
1. Disable high voltage. (Refer to “High Voltage Disable” procedure in this manual.)

IMPORTANT: Be sure to test for high voltage as described in the “High Voltage” disable procedure.

2. Remove underhood beauty panel
3. Disconnect cannon connector from charge receptacle to power inverter module (PIM).
4. Remove two bolts from the charge receptacle cable bracket to fan shroud.
5. Disconnect the three wire fasteners freeing the Charge receptacle cable from the fan shroud.
6. Raise the vehicle on a hoist. (Refer to “Lifting, Jacking and Support Points” procedure in this manual.)
7. Remove front underbody air deflector. (Refer to “Underbody Front Air Deflector Removal” procedure in this manual.)



PSMPEN66657AA



PSMPEN66381AB

8. Disconnect the eight-way black connector.
9. Disconnect eight-way connector body fastener from front end panel.

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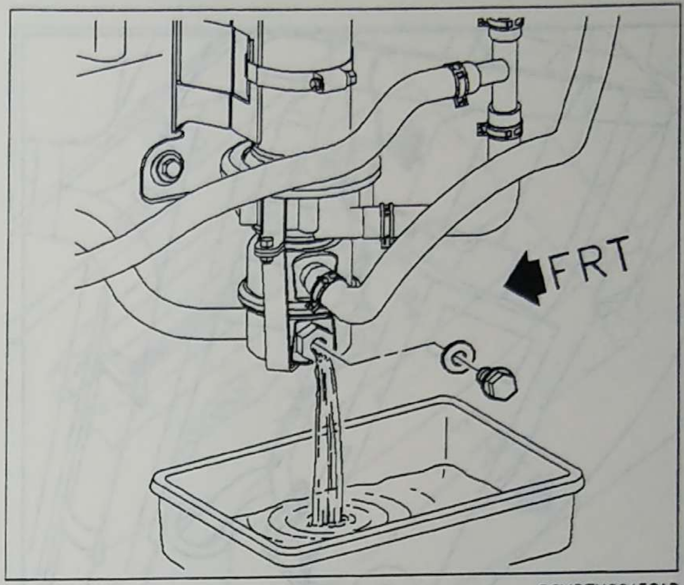
10. Drain coolant from pump.
11. Remove and plug the two coolant hoses.

NOTICE: **Some coolant will remain in charge receptacle.**

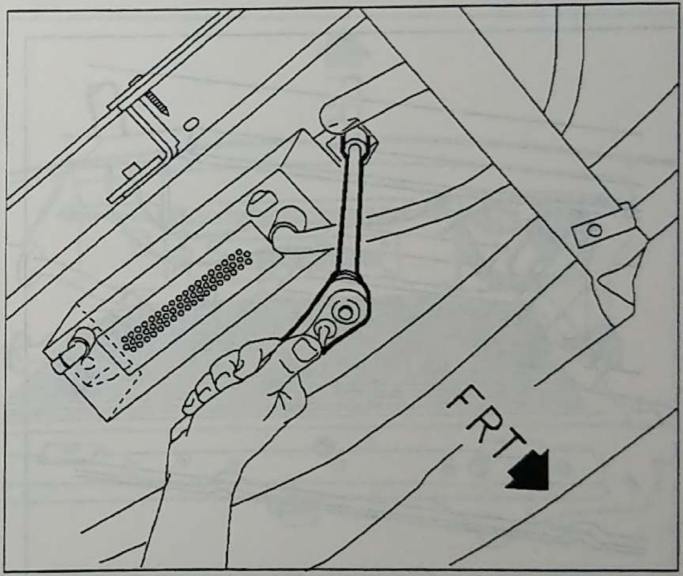
12. Plug both coolant lines on charge receptacle with rubber caps.
13. Using a screw driver carefully remove the grommet from the side panel and pull charge receptacle cable out.

NOTICE: **Hang cannon connector in the side panel opening . This will keep it from interfering with further procedures and possible damage.**



PSMPEN66458AB

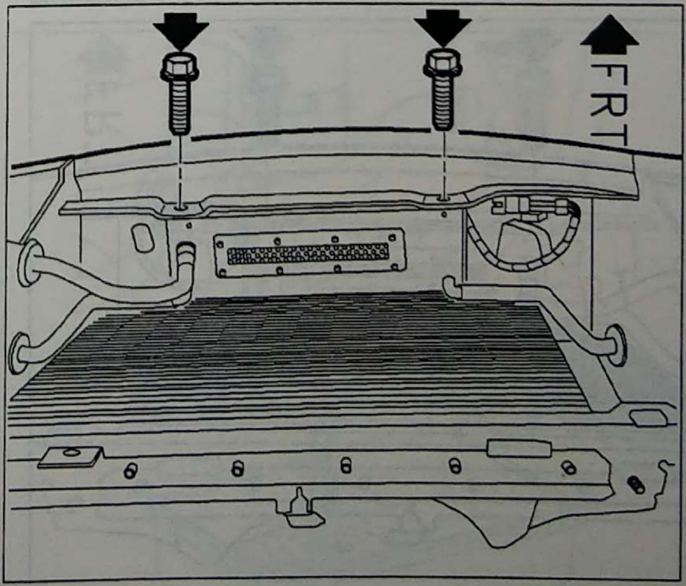
14. Remove the two upper charge receptacle bolts.



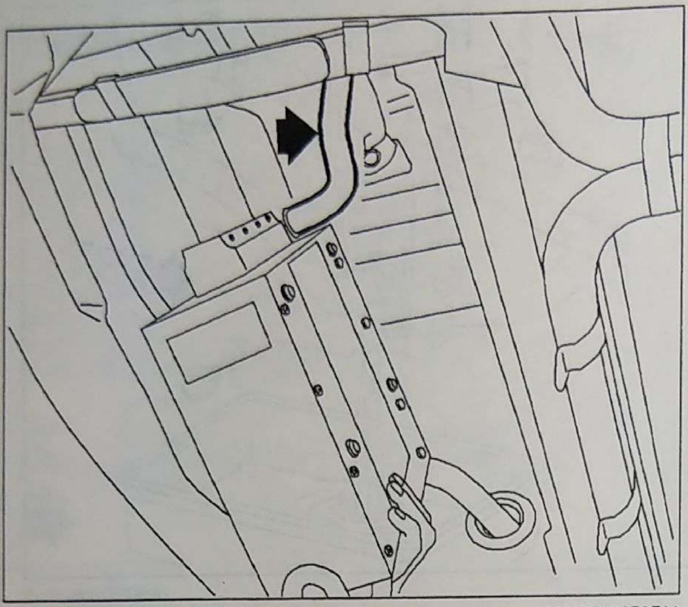
PSMPEN66392AA

15. Remove the two lower charge receptacle bolts while supporting the charge receptacle.

NOTICE: **Have pliers ready to remove vent hose clamp.**



PSMPEN66381AA



PSMPEN66393AA

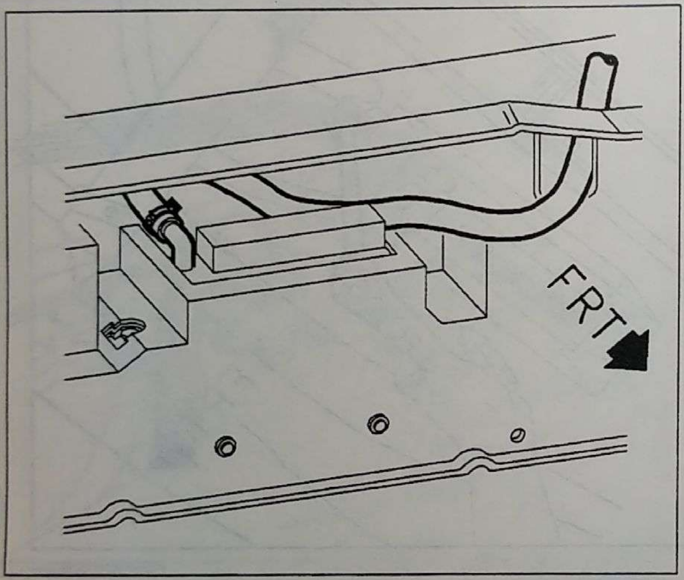
16. Slowly lower charge receptacle until you can see the vent hose. Disconnect the vent hose and remove the charge receptacle.

IMPORTANT: Do not allow charge receptacle to hang from vent hose.

INSTALLATION

1. Lift the charge receptacle up and connect vent hose.

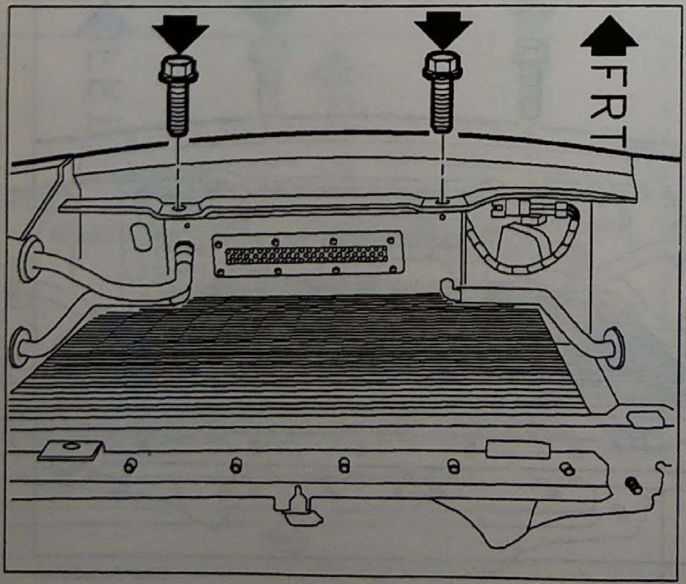
IMPORTANT: Do not allow charge receptacle to hang from vent hose.



PSMELC66927AA

2. Carefully lift the charge receptacle up while an assistant (who is on a ladder) guides the vent hose into position. Assistant should reach through charge receptacle door and position hose between front end panel and charge receptacle door.

IMPORTANT: Do not force charge receptacle. Pinching of the vent hose may occur resulting in improper charge receptacle cooling.



PSMPEN66381AA

3. Push charge receptacle up and install lower bolts.

Torque: **10 N•m (89 in-lbs)**

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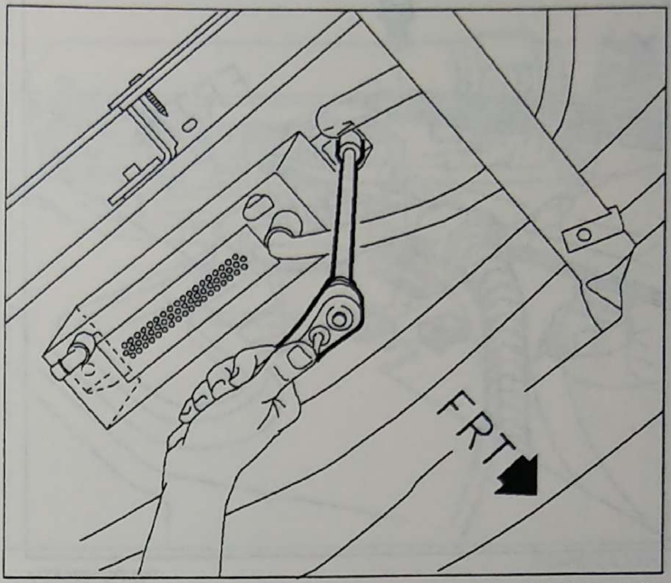
4. Install upper charge receptacle bolts.

Torque: **10 N•m (89 in-lbs)**

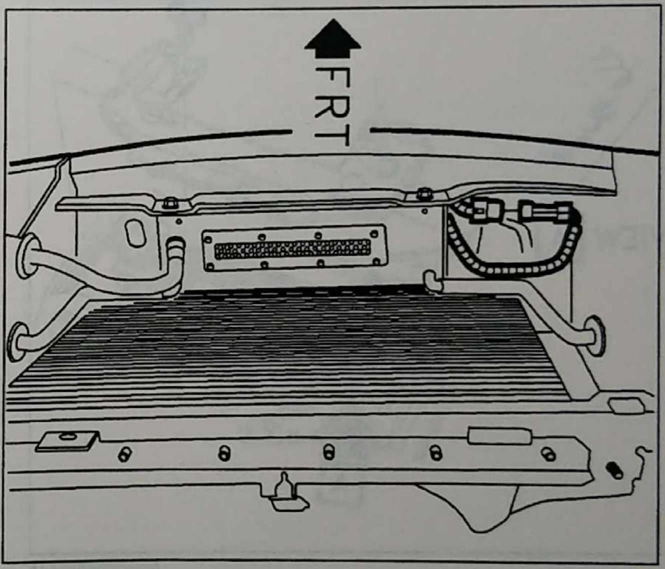
5. Route charge receptacle cable through side panel hole and install grommet.



PSMPEN66392AA

6. Connect eight-way black connector and plug fastener into front end panel.

7. Remove caps from charge receptacle and plugs from coolant hoses and connect to charge receptacle.



PSMPEN66381AB

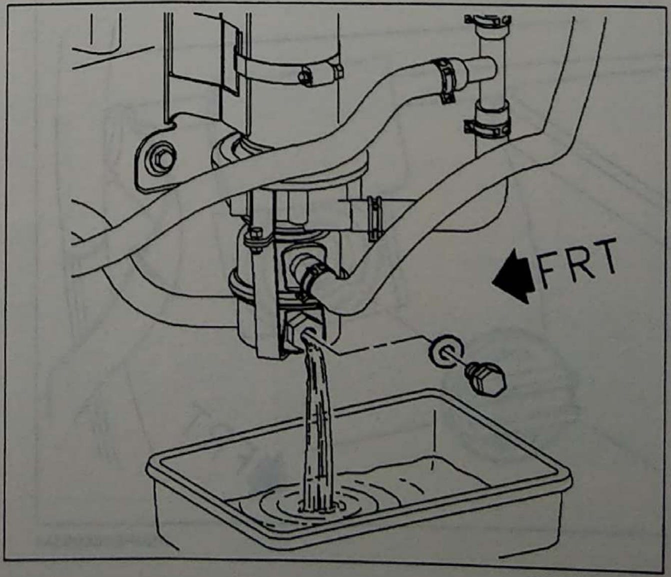
8. Replace plug in coolant pump.

Torque: **12 N•m (106 in-lbs)**

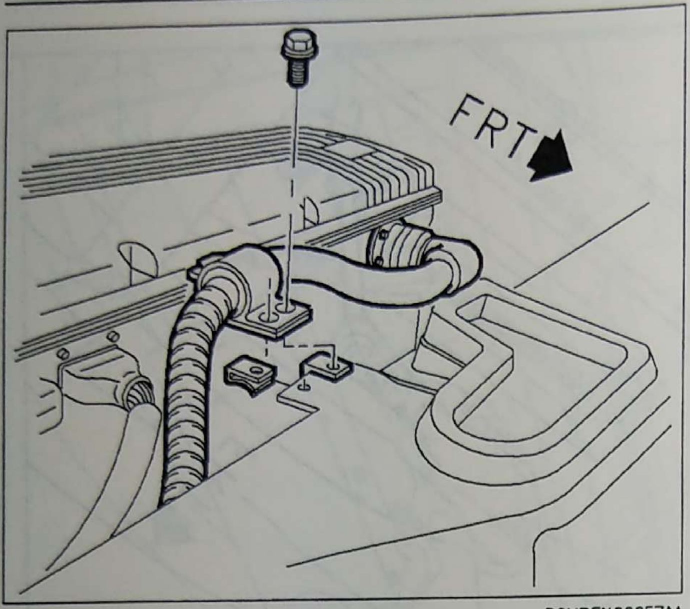
9. Install front underbody air deflector.

Torque: **7 N•m (62 in-lbs)**

10. Lower vehicle.



PSMPEN66458AB

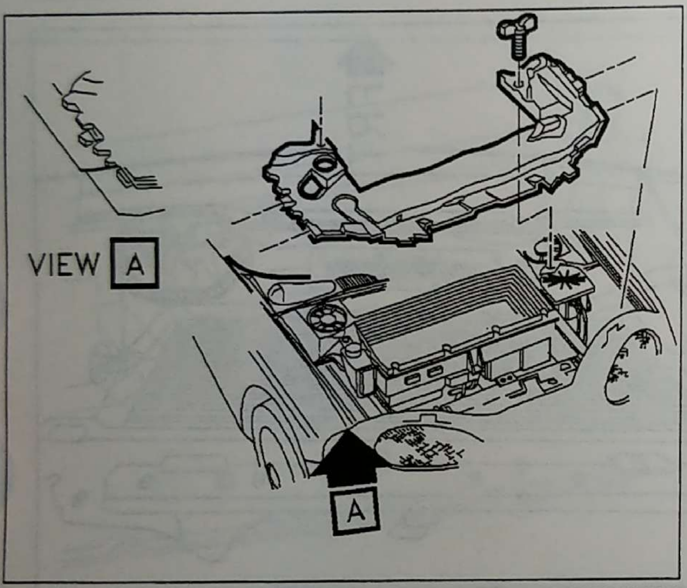


PSMPEN66657AA

11. Install the bracket holding high voltage cable.

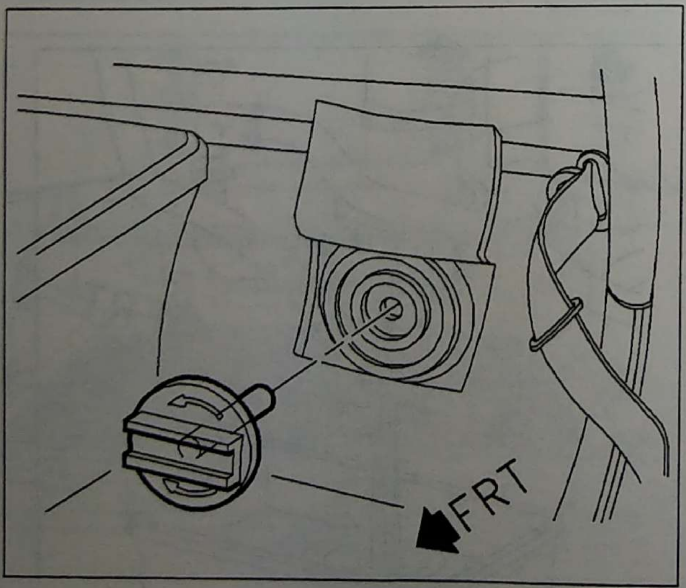
Torque: **10 N•m (89 in-lbs)**

12. Install the high voltage cable in the two wire clips on the fan shroud. Install the cable fastener in the fan shroud tab.



PSMGEP65869AC

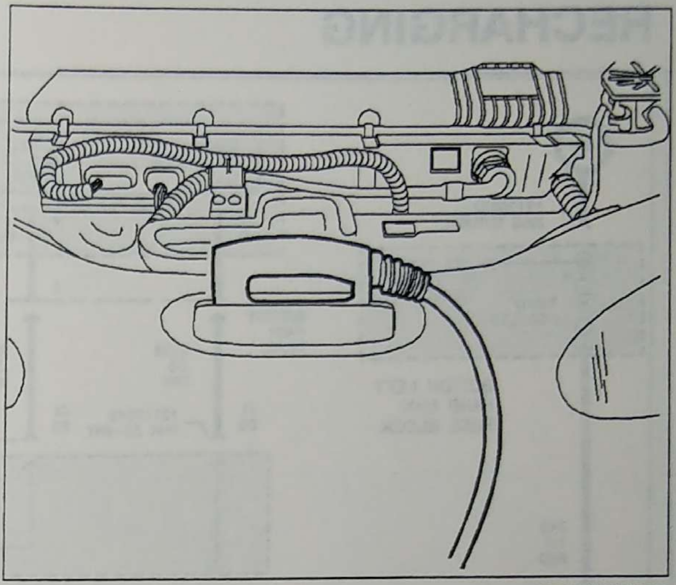
13. Install the front compartment cover.



PSMPEN65995AA

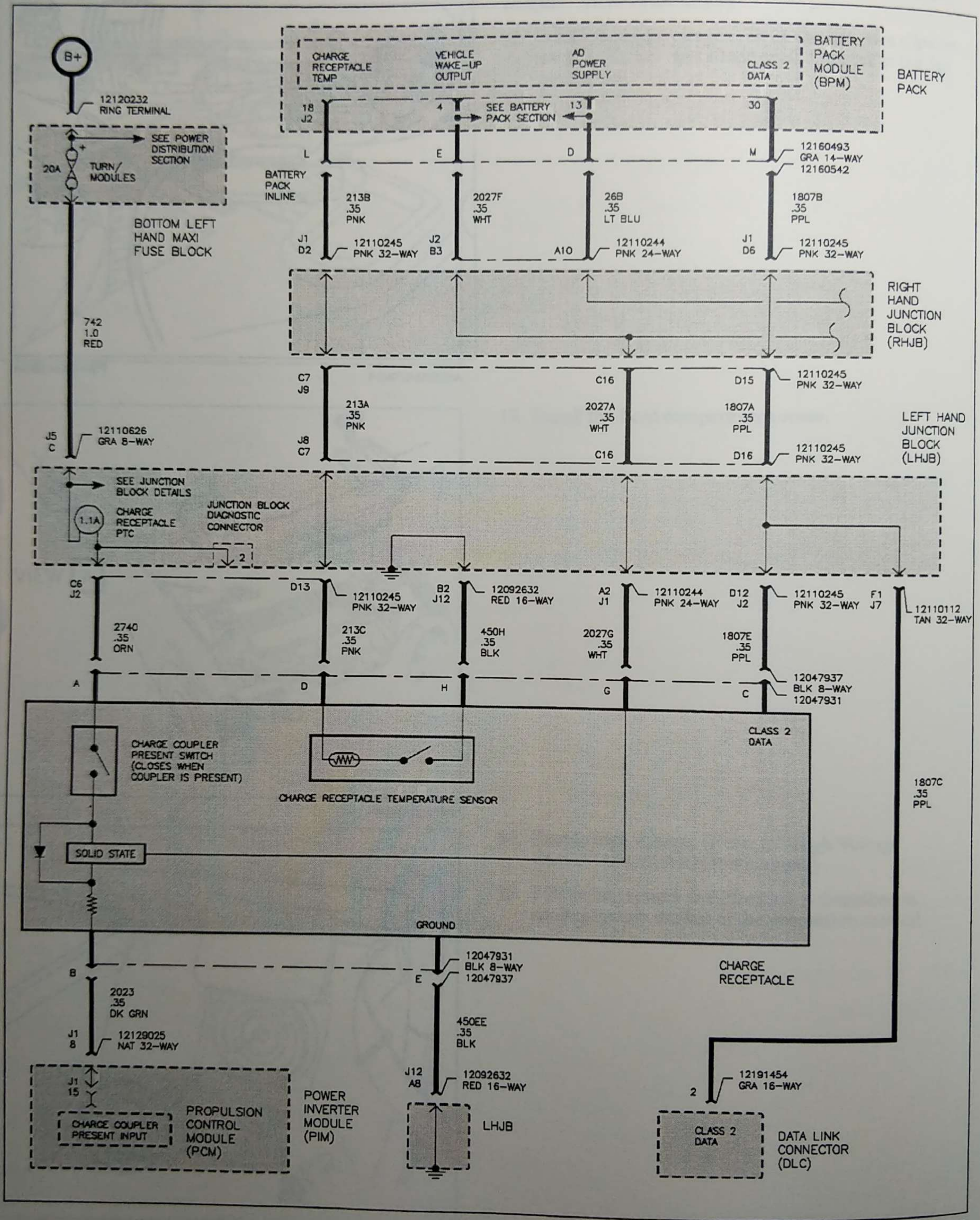
14. Enable high voltage. (Refer to "High Voltage Enable" procedure in this manual.)
15. Fill cooling system and bleed air as described in cooling system section of the propulsion manual.

16. Charge vehicle to verify proper charge receptacle operation.

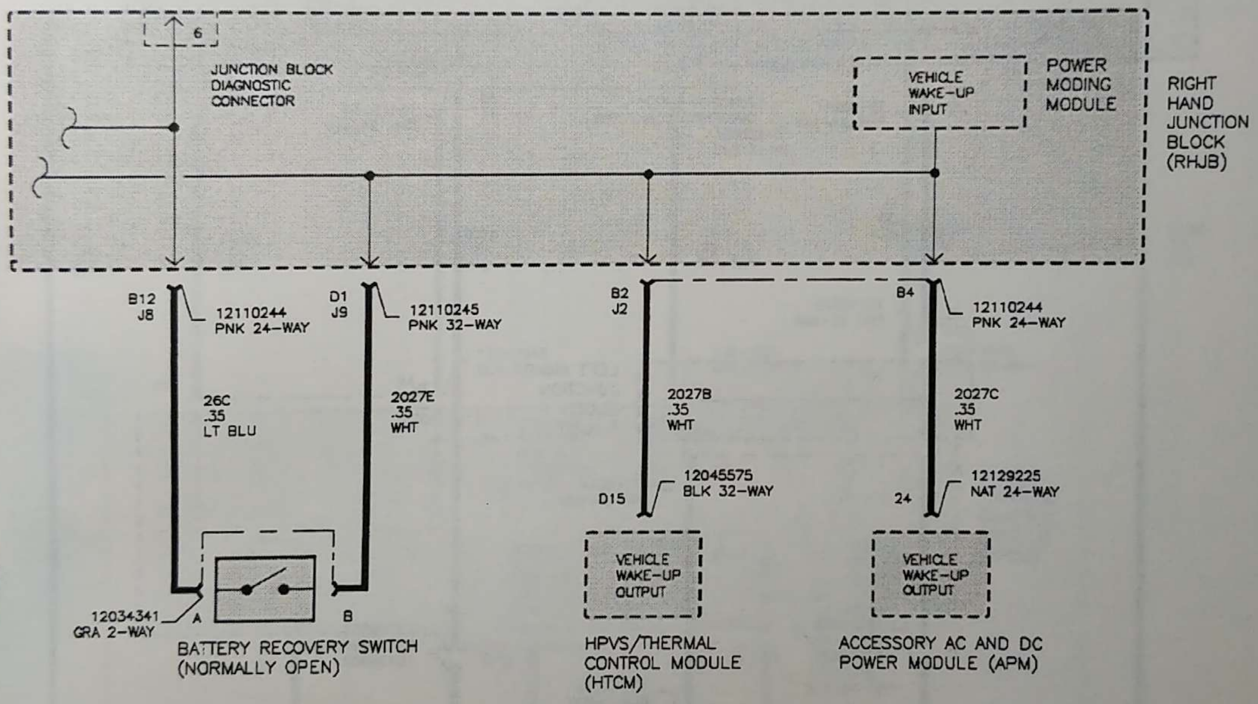


PSMPEN66380AA

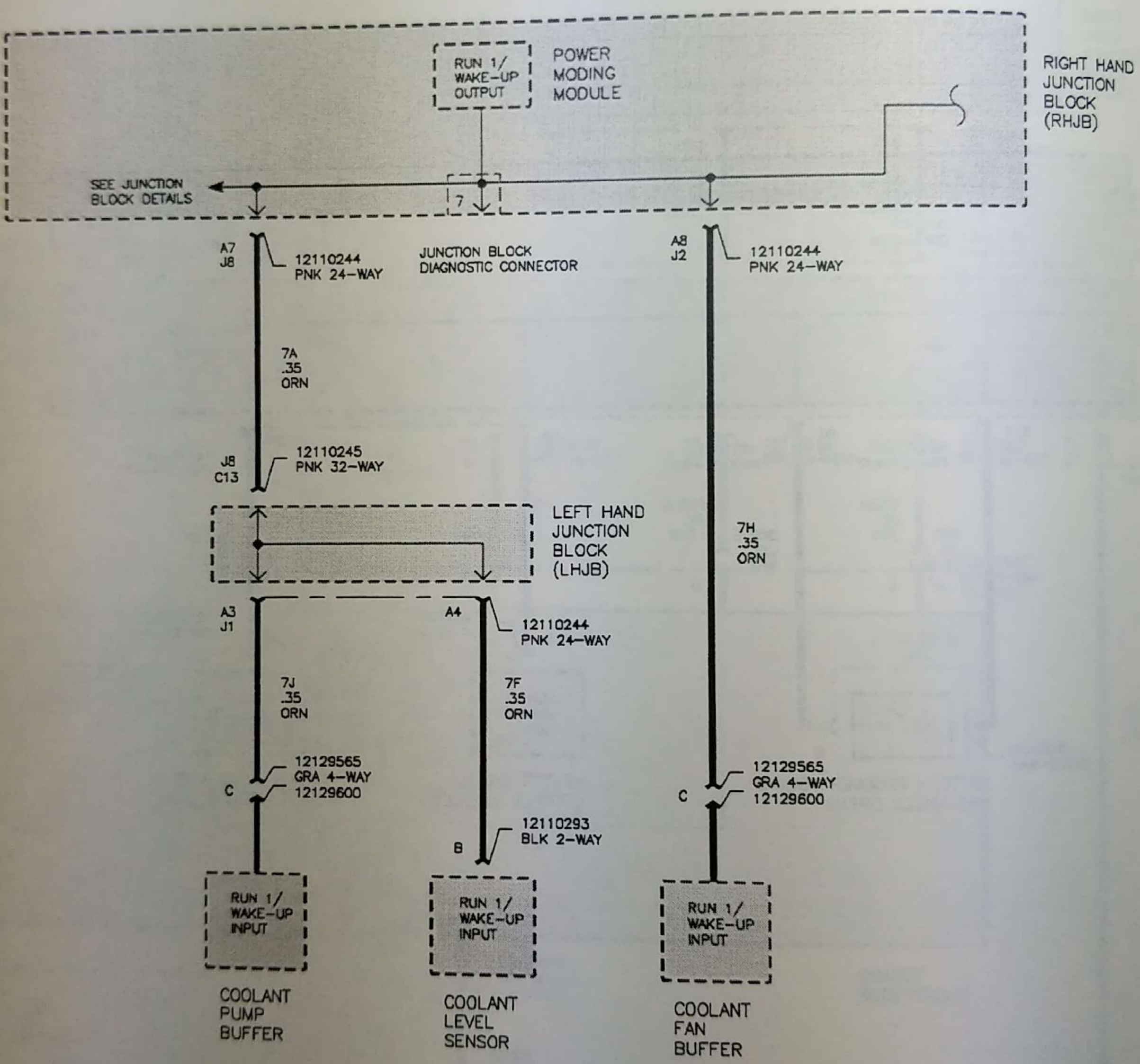
RECHARGING


B+
12120232
RING TERMINAL
SEE POWER DISTRIBUTION SECTION
20A
TURN/ MODULES
BOTTOM LEFT HAND MAXI FUSE BLOCK
742
1.0
RED
J5
C
12110626
GRA 8-WAY
CHARGE RECEPTACLE TEMP
VEHICLE WAKE-UP OUTPUT
AD POWER SUPPLY
CLASS 2 DATA
BATTERY PACK MODULE (BPM)
BATTERY PACK
18
J2
4
SEE BATTERY PACK SECTION
13
30
L
E
D
M
12160493
GRA 14-WAY
12160542
BATTERY PACK INLINE
213B
.35
PNK
2027F
.35
WHT
26B
.35
LT BLU
1807B
.35
PPL
J1
D2
12110245
PNK 32-WAY
J2
B3
A10
12110244
PNK 24-WAY
J1
D6
12110245
PNK 32-WAY
RIGHT HAND JUNCTION BLOCK (RHJB)
C7
J9
213A
.35
PNK
J8
C7
C16
2027A
.35
WHT
C16
D15
1807A
.35
PPL
D16
12110245
PNK 32-WAY
12110245
PNK 32-WAY
LEFT HAND JUNCTION BLOCK (LHJB)
SEE JUNCTION BLOCK DETAILS
1.1A
CHARGE RECEPTACLE PTC
JUNCTION BLOCK DIAGNOSTIC CONNECTOR
2
C6
J2
2740
.35
ORN
D13
12110245
PNK 32-WAY
213C
.35
PNK
B2
J12
12092632
RED 16-WAY
450H
.35
BLK
A2
J1
12110244
PNK 24-WAY
2027G
.35
WHT
D12
J2
12110245
PNK 32-WAY
1807E
.35
PPL
F1
J7
12110112
TAN 32-WAY
A
D
H
G
C
12047937
BLK 8-WAY
12047931
CHARGE COUPLER PRESENT SWITCH (CLOSES WHEN COUPLER IS PRESENT)
CHARGE RECEPTACLE TEMPERATURE SENSOR
CLASS 2 DATA
1807C
.35
PPL
SOLID STATE
GROUND
B
E
12047931
BLK 8-WAY
12047937
CHARGE RECEPTACLE
2023
.35
DK GRN
J1
8
12129025
NAT 32-WAY
450EE
.35
BLK
J12
A8
12092632
RED 16-WAY
2
12191454
GRA 16-WAY
J1
15
CHARGE COUPLER PRESENT INPUT
PROPULSION CONTROL MODULE (PCM)
POWER INVERTER MODULE (PIM)
LHJB
CLASS 2 DATA
DATA LINK CONNECTOR (DLC)

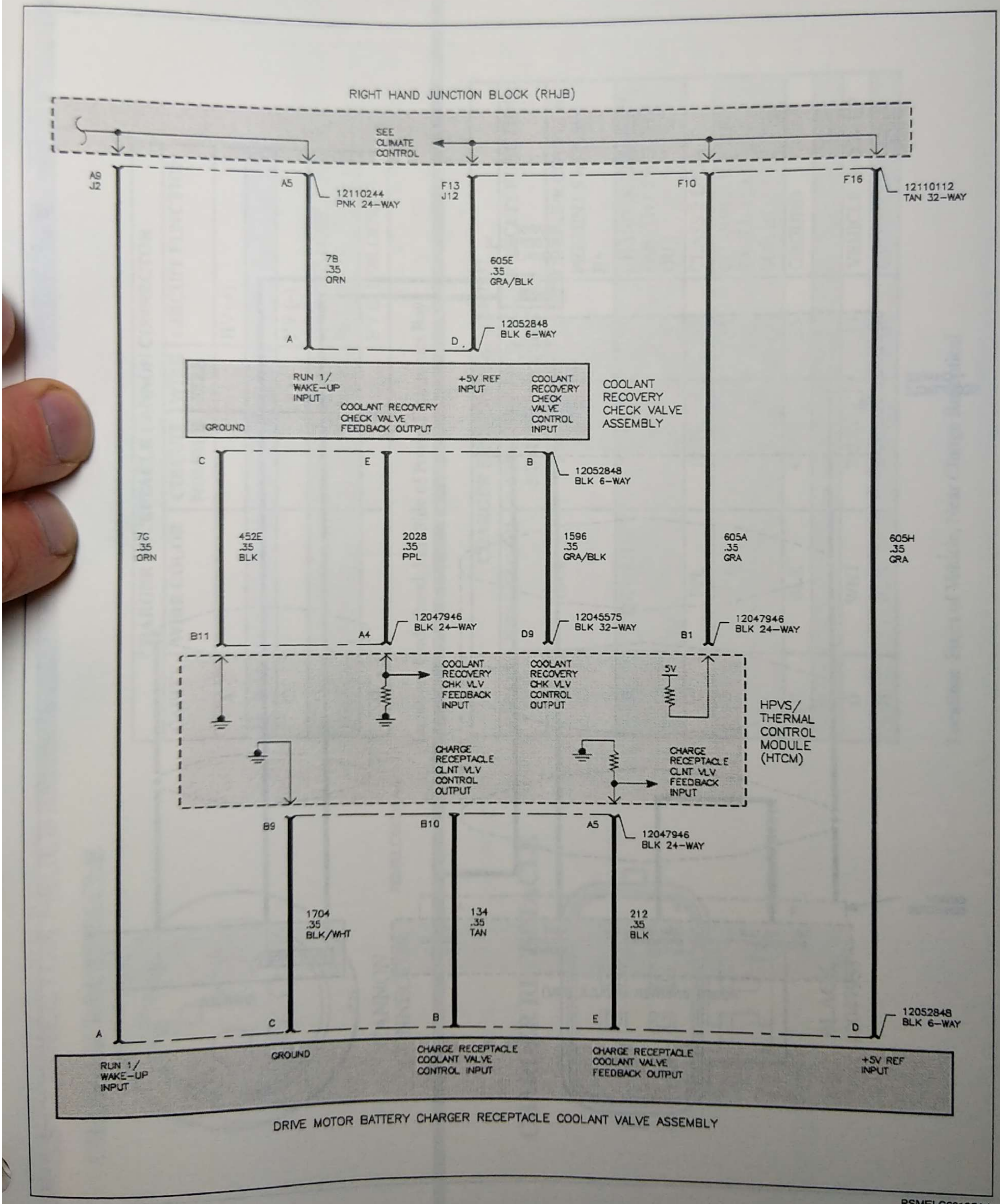
PSMELC68132AA


6
JUNCTION BLOCK DIAGNOSTIC CONNECTOR
VEHICLE WAKE-UP INPUT
POWER MODING MODULE
RIGHT HAND JUNCTION BLOCK (RHJB)
B12
J8
12110244
PNK 24-WAY
D1
J9
12110245
PNK 32-WAY
B2
J2
B4
12110244
PNK 24-WAY
26C
.35
LT BLU
2027E
.35
WHT
2027B
.35
WHT
2027C
.35
WHT
D15
12045575
BLK 32-WAY
24
12129225
NAT 24-WAY
VEHICLE WAKE-UP OUTPUT
VEHICLE WAKE-UP OUTPUT
12034341
GRA 2-WAY
A
B
BATTERY RECOVERY SWITCH (NORMALLY OPEN)
HPVS/THERMAL CONTROL MODULE (HTCM)
ACCESSORY AC AND DC POWER MODULE (APM)

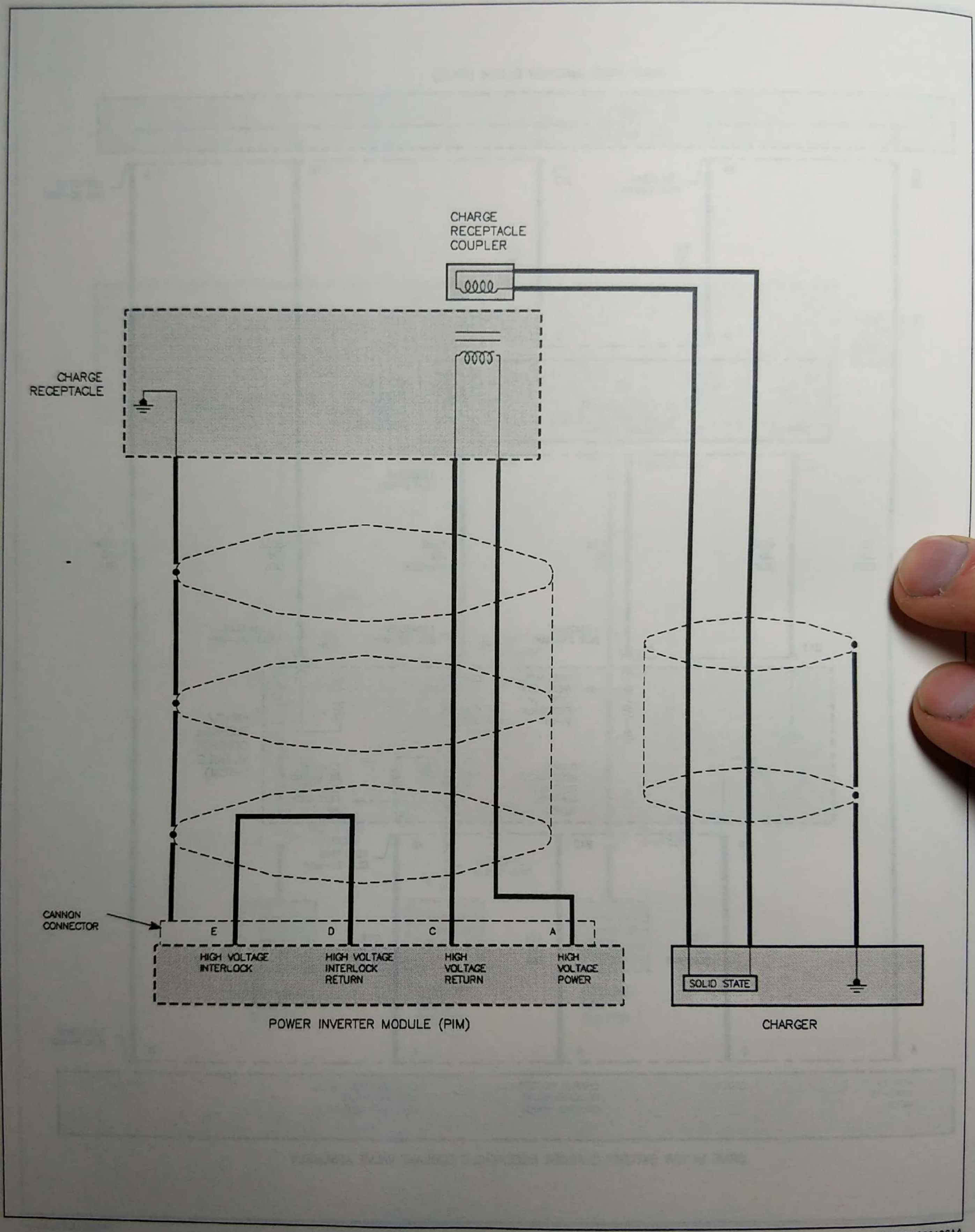
PSKMELC68133AA


RUN 1/
WAKE-UP
OUTPUT
POWER
MODING
MODULE
RIGHT HAND
JUNCTION
BLOCK
(RHJB)
SEE JUNCTION
BLOCK DETAILS
7
A7
J8
12110244
PNK 24-WAY
JUNCTION BLOCK
DIAGNOSTIC CONNECTOR
A8
J2
12110244
PNK 24-WAY
7A
.35
ORN
J8
C13
12110245
PNK 32-WAY
LEFT HAND
JUNCTION
BLOCK
(LHJB)
7H
.35
ORN
A3
J1
A4
12110244
PNK 24-WAY
7J
.35
ORN
7F
.35
ORN
12129565
GRA 4-WAY
12129600
C
12129565
GRA 4-WAY
12129600
C
12110293
BLK 2-WAY
B
RUN 1/
WAKE-UP
INPUT
RUN 1/
WAKE-UP
INPUT
RUN 1/
WAKE-UP
INPUT
COOLANT
PUMP
BUFFER
COOLANT
LEVEL
SENSOR
COOLANT
FAN
BUFFER

PSMELC68134AA


RIGHT HAND JUNCTION BLOCK (RHJB)
SEE CLIMATE CONTROL
A9 J2
A5
12110244 PNK 24-WAY
F13 J12
F10
F16
12110112 TAN 32-WAY
78 .35 ORN
605E .35 GRA/BLK
A
D
12052848 BLK 6-WAY
RUN 1/ WAKE-UP INPUT
+5V REF INPUT
COOLANT RECOVERY CHECK VALVE CONTROL INPUT
COOLANT RECOVERY CHECK VALVE FEEDBACK OUTPUT
GROUND
COOLANT RECOVERY CHECK VALVE ASSEMBLY
C
E
B
12052848 BLK 6-WAY
7G .35 ORN
452E .35 BLK
2028 .35 PPL
1596 .35 GRA/BLK
605A .35 GRA
605H .35 GRA
12047946 BLK 24-WAY
12045575 BLK 32-WAY
12047946 BLK 24-WAY
B11
A4
D9
B1
COOLANT RECOVERY CHK VLV FEEDBACK INPUT
COOLANT RECOVERY CHK VLV CONTROL OUTPUT
5V
CHARGE RECEPTACLE CLNT VLV CONTROL OUTPUT
CHARGE RECEPTACLE CLNT VLV FEEDBACK INPUT
HPVS/ THERMAL CONTROL MODULE (HTCM)
B9
B10
A5
12047946 BLK 24-WAY
1704 .35 BLK/WHT
134 .35 TAN
212 .35 BLK
A
C
B
E
D
12052848 BLK 6-WAY
RUN 1/ WAKE-UP INPUT
GROUND
CHARGE RECEPTACLE COOLANT VALVE CONTROL INPUT
CHARGE RECEPTACLE COOLANT VALVE FEEDBACK OUTPUT
+5V REF INPUT
DRIVE MOTOR BATTERY CHARGER RECEPTACLE COOLANT VALVE ASSEMBLY

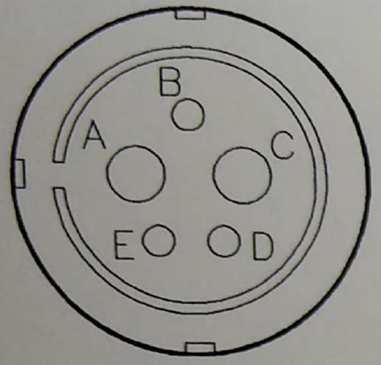
PSMELC68135AA


CHARGE
RECEPTACLE
COUPLER
CHARGE
RECEPTACLE
CANNON
CONNECTOR
E
D
C
A
HIGH VOLTAGE
INTERLOCK
HIGH VOLTAGE
INTERLOCK
RETURN
HIGH
VOLTAGE
RETURN
HIGH
VOLTAGE
POWER
POWER INVERTER MODULE (PIM)
SOLID STATE
CHARGER

PSMELC68136AA

HARNESS CONNECTOR FACES

CHARGER RECEPTACLE



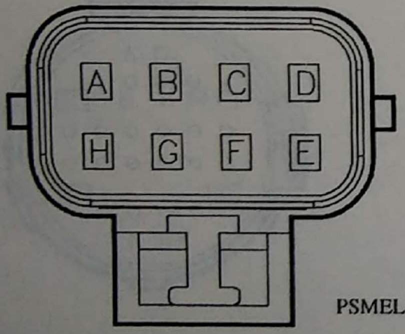
CANNON
CONNECTOR

PSMELC68239AA

CHARGER RECEPTACLE CANNON CONNECTOR				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A				HV (+)
B				
C				HV (–)
D				HV INTERLOCK RETURN (–)
E				HV INTERLOCK (+)

Location: Underhood, Left Side of Power Electronics Bay

CHARGER RECEPTACLE



PSMELC67217AA

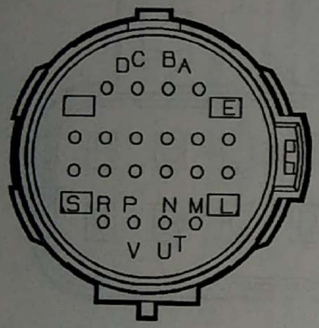
BLACK
12047937

CHARGER RECEPTACLE – 12047937				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	ORN	2740	.35	CHARGER COUPLER PRESENT SWITCH B+
B	DK GRN	2023	.35	CHARGER COUPLER PRESENT SWITCH OUT
C	PPL	1807E	.35	CLASS 2 DATA
D	PNK	213C	.35	CHARGER RECEPTACLE TEMP SENSOR HI
E	BLK	450EE	.35	GROUND
F				
G	WHT	2027G	.35	VEHICLE WAKE–UP
H	BLK	450H	.35	GROUND

Location: Front of Vehicle, Near Charge Receptical

HARNESS CONNECTOR FACES

BATTERY PACK INLINE



GRAY
12160544

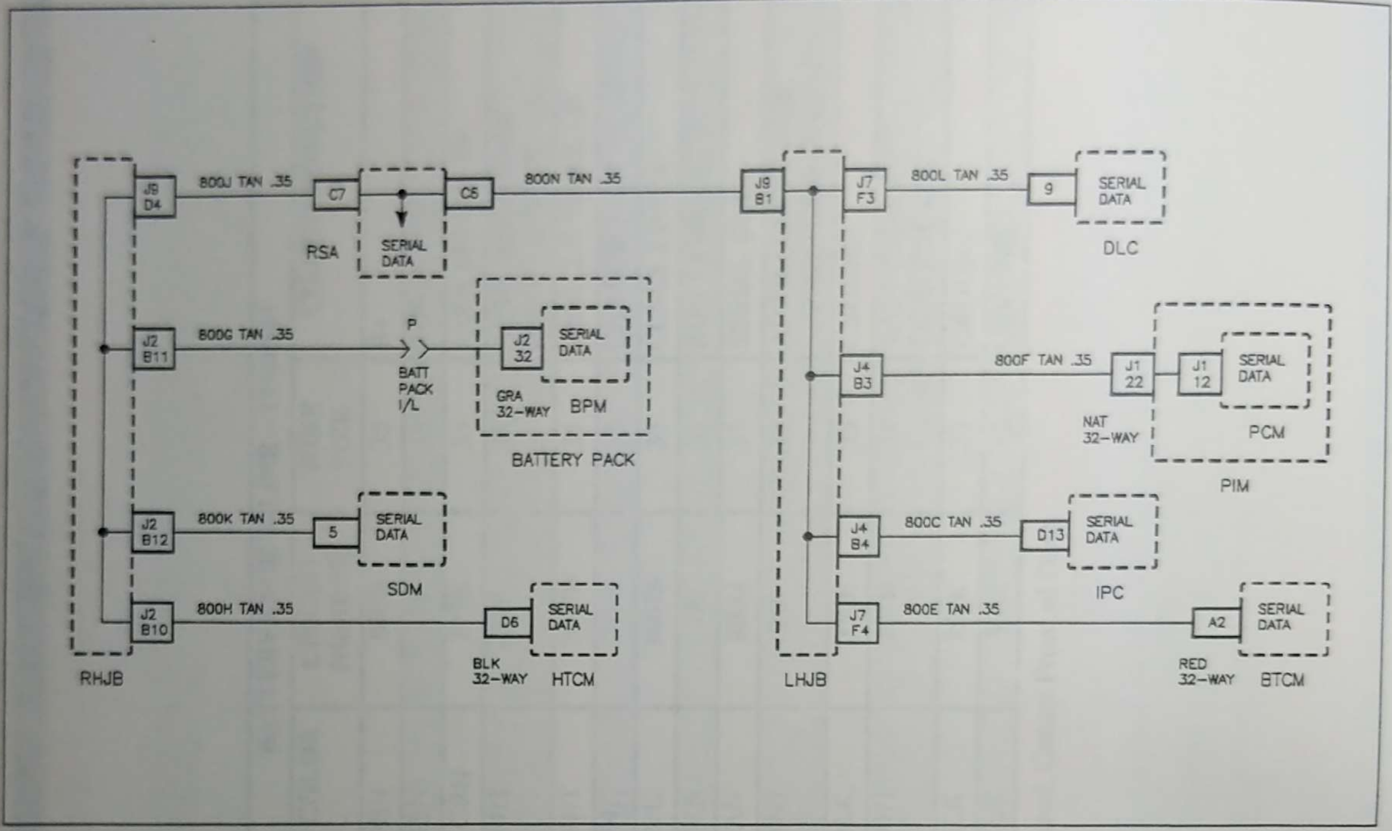
PSMELC67244AA

BATTERY PACK INLINE – 12160544				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	ORN	840B	.35	B+
B	BRN	41S	.35	RUN 1
C	LT GRN	275B	.35	PARK SELECT IN
D	WHT	26B	.35	AUTO DISCONNECT POWER SUPPLY
E	WHT	2027F	.35	VEHICLE WAKE-UP
L	PNK	213B	.35	CHARGE PORT TEMP IN
M	PPL	1807B	.35	CLASS 2 DATA
N	ORN	7K	.35	RUN 1 / WAKE-UP
P	TAN	800G	.35	SERIAL DATA
R	WHT	249	.35	AUXILIARY POWER SUPPLY COMMAND OUT
S	BLK	350E	.35	GROUND
T	WHT	108B	.35	BATT PACK FAN CONTROL OUT
U	BLK	350K	.35	GROUND
V	BLK	350S	.35	GROUND

Location: Underhood, Center Front of Dash

NOTES

DTC 297 – BRAKE/TORQUE CONTROL MODULE (BTCM) COMMUNICATION FAULT


RHJB
J9 D4
800J TAN .35
C7
RSA
SERIAL DATA
C6
800N TAN .35
J2 B11
800G TAN .35
P
BATT PACK I/L
J2 32
SERIAL DATA
GRA 32-WAY
BPM
BATTERY PACK
J2 B12
800K TAN .35
5
SERIAL DATA
SDM
J2 B10
800H TAN .35
D6
SERIAL DATA
BLK 32-WAY
HTCM
LHJB
J9 B1
J7 F3
800L TAN .35
9
SERIAL DATA
DLC
J4 B3
800F TAN .35
J1 22
J1 12
SERIAL DATA
NAT 32-WAY
PCM
PIM
J4 B4
800C TAN .35
D13
SERIAL DATA
IPC
J7 F4
800E TAN .35
A2
SERIAL DATA
RED 32-WAY
BTCM

PSMELC68207AA

BRAKE/TORQUE CONTROL MODULE (BTCM) COMMUNICATION FAULT

All of the controllers communicate over the universal asynchronous receiver (UART) line. The battery pack module (BPM) is the master of the uart line and will request information from each controller in a specified order. All other controllers listen on the line for information required to perform their operations.

DTC PARAMETERS

This DTC will set anytime the BPM has requested information from the brake/torque control module (BTCM) and the BTCM did not respond for 10 seconds.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Other serial data DTCs.

TELLTALE ILLUMINATED

None

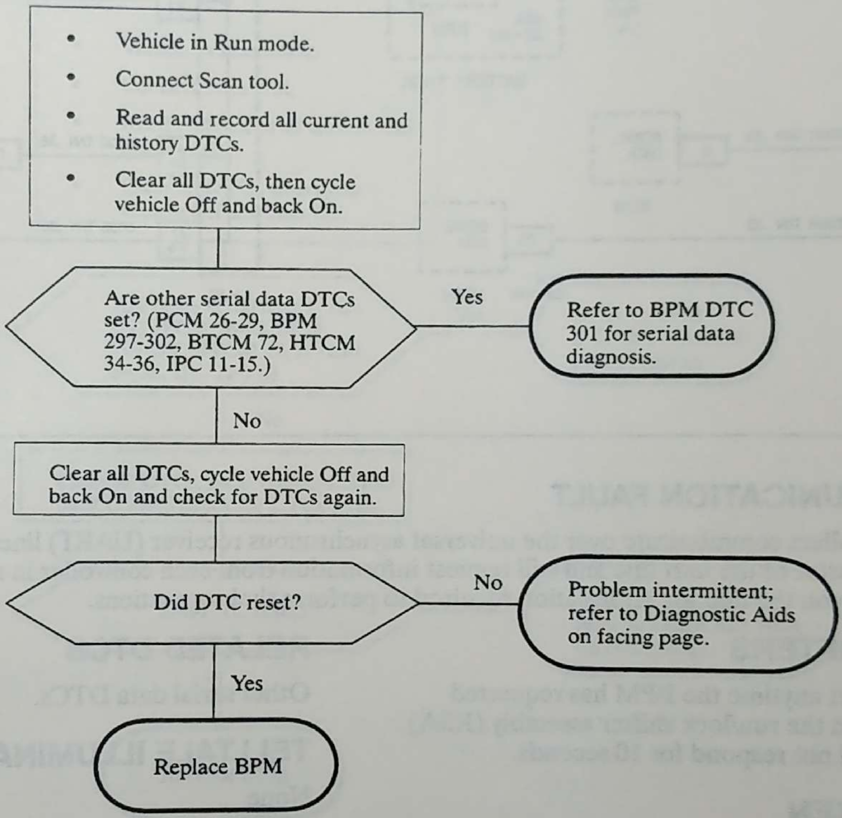
DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

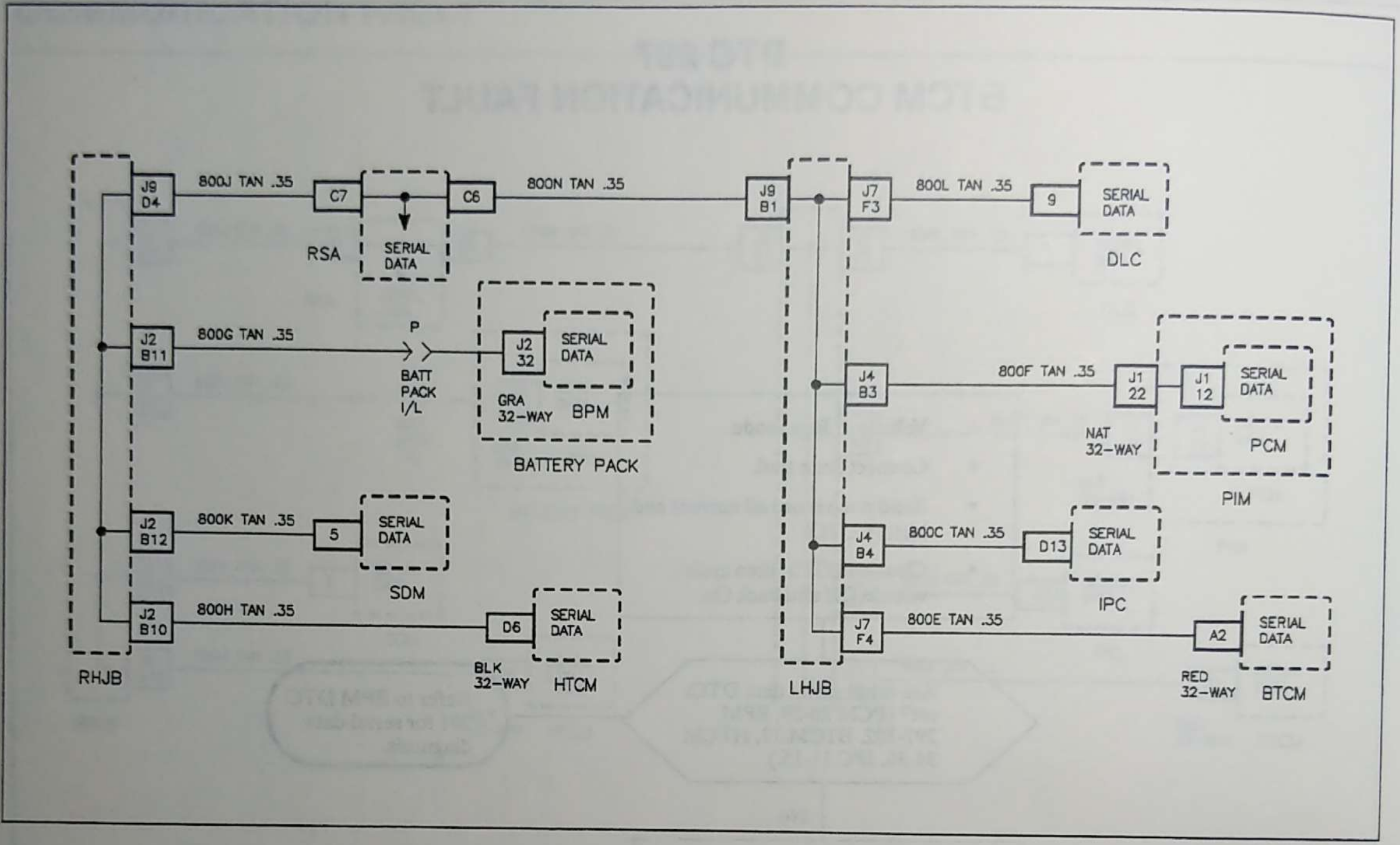
Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

DTC 297
BTCM COMMUNICATION FAULT


• Vehicle in Run mode.
• Connect Scan tool.
• Read and record all current and history DTCs.
• Clear all DTCs, then cycle vehicle Off and back On.
Are other serial data DTCs set? (PCM 26-29, BPM 297-302, BTCM 72, HTCM 34-36, IPC 11-15.)
Yes
Refer to BPM DTC 301 for serial data diagnosis.
No
Clear all DTCs, cycle vehicle Off and back On and check for DTCs again.
Did DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Replace BPM

DTC 298 – RSA COMMUNICATION FAULT


J9
D4
800J TAN .35
C7
RSA
SERIAL DATA
C6
800N TAN .35
J9
B1
J7
F3
800L TAN .35
9
SERIAL DATA
DLC
J2
B11
800G TAN .35
P
BATT PACK I/L
J2
32
SERIAL DATA
GRA 32–WAY
BPM
BATTERY PACK
J4
B3
800F TAN .35
J1
22
J1
12
SERIAL DATA
NAT 32–WAY
PCM
PIM
J2
B12
800K TAN .35
5
SERIAL DATA
SDM
J4
B4
800C TAN .35
D13
SERIAL DATA
IPC
J2
B10
800H TAN .35
D6
SERIAL DATA
BLK 32–WAY
HTCM
RHJB
LHJB
J7
F4
800E TAN .35
A2
SERIAL DATA
RED 32–WAY
BTCM

PSMELC68207AA

RSA COMMUNICATION FAULT

All of the controllers communicate over the universal asynchronous receiver (UART) line. The battery pack module (BPM) is the master of the uart line and will request information from each controller in a specified order. All other controllers listen on the line for information required to perform their operations.

DTC PARAMETERS

This DTC will set anytime the BPM has requested information from the run/lock shifter assembly (RSA) and the RSA did not respond for 10 seconds.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Other serial data DTCs.

TELLTALE ILLUMINATED

None

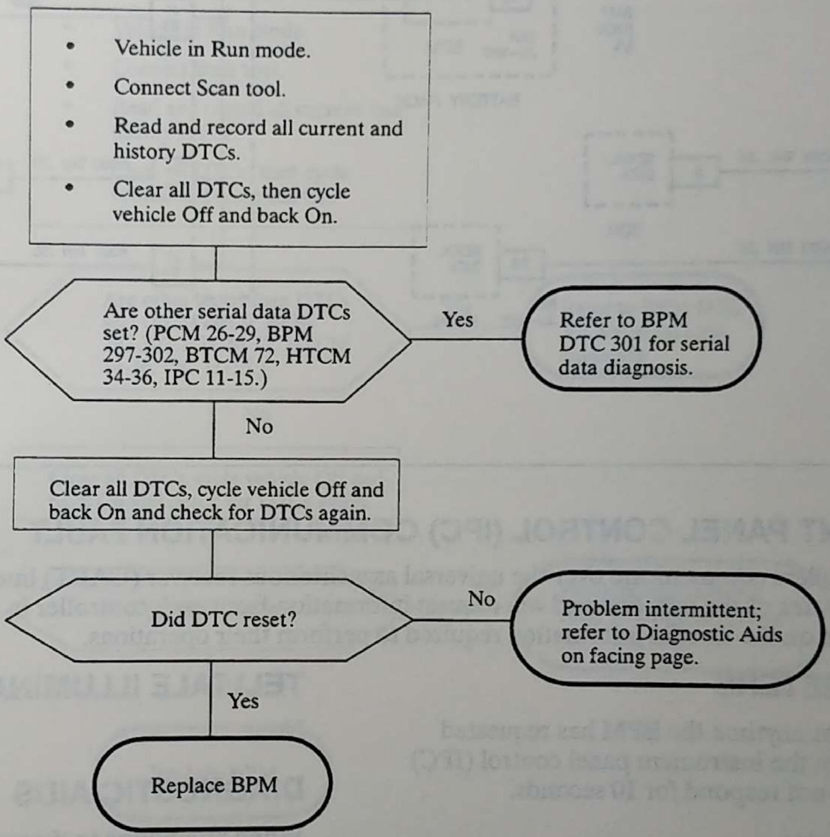
DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

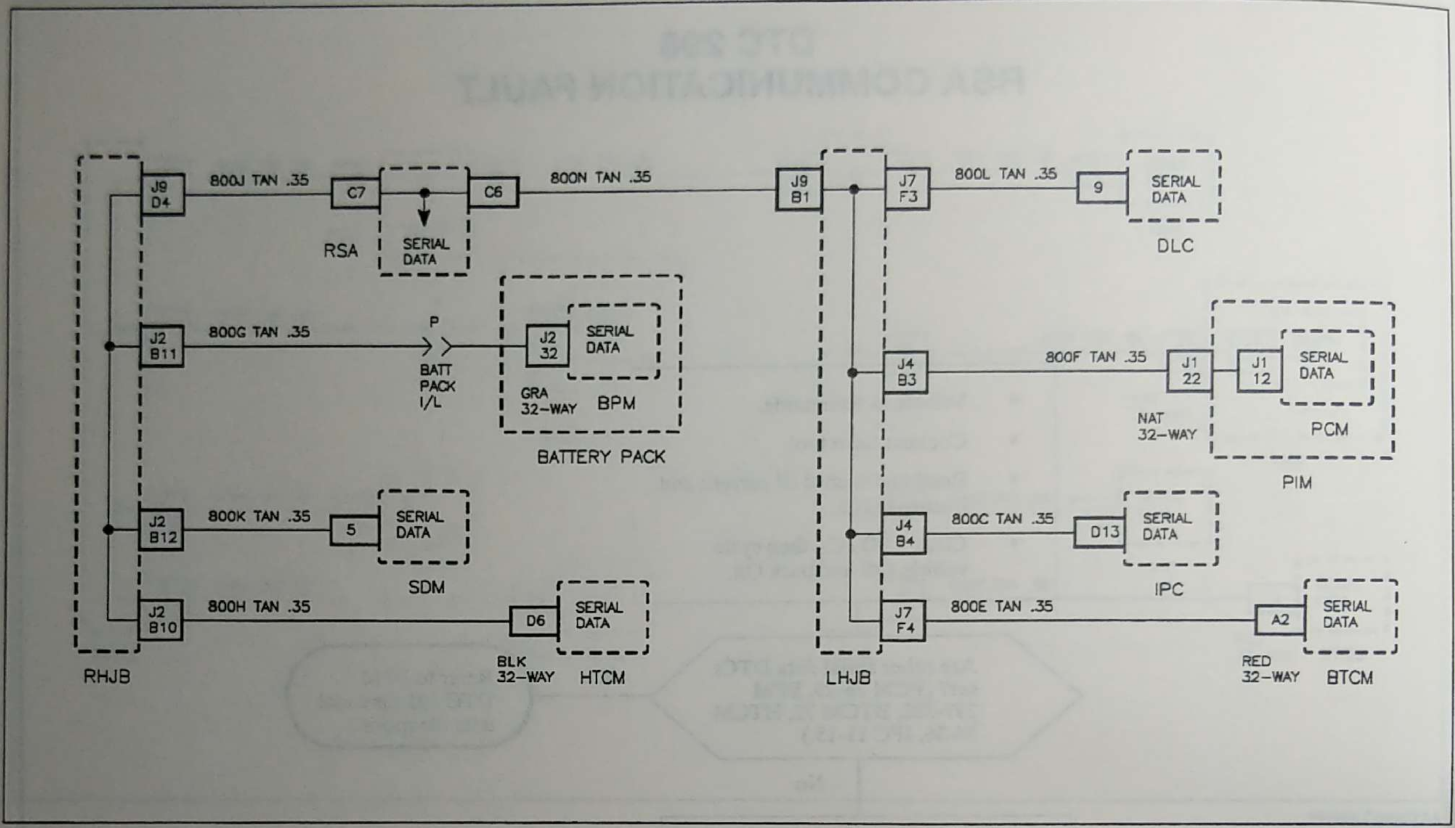
Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

DTC 298
RSA COMMUNICATION FAULT


• Vehicle in Run mode.
• Connect Scan tool.
• Read and record all current and history DTCs.
• Clear all DTCs, then cycle vehicle Off and back On.
Are other serial data DTCs set? (PCM 26-29, BPM 297-302, BTCM 72, HTCM 34-36, IPC 11-15.)
Yes
Refer to BPM DTC 301 for serial data diagnosis.
No
Clear all DTCs, cycle vehicle Off and back On and check for DTCs again.
Did DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Replace BPM

DTC 299 – INSTRUMENT PANEL CONTROL (IPC) COMMUNICATION FAULT


J9 D4
800J TAN .35
C7
RSA
SERIAL DATA
C6
800N TAN .35
J9 B1
J7 F3
800L TAN .35
9
SERIAL DATA
DLC
J2 B11
800G TAN .35
P
BATT PACK I/L
J2 32
SERIAL DATA
GRA 32–WAY
BPM
BATTERY PACK
J4 B3
800F TAN .35
J1 22
J1 12
SERIAL DATA
NAT 32–WAY
PCM
PIM
J2 B12
800K TAN .35
5
SERIAL DATA
SDM
J4 B4
800C TAN .35
D13
SERIAL DATA
IPC
J2 B10
800H TAN .35
D6
SERIAL DATA
BLK 32–WAY
HTCM
RHJB
LHJB
J7 F4
800E TAN .35
A2
SERIAL DATA
RED 32–WAY
BTCM

PSMELC68207AA

INSTRUMENT PANEL CONTROL (IPC) COMMUNICATION FAULT

All of the controllers communicate over the universal asynchronous receiver (UART) line. The battery pack module (BPM) is the master of the uart line and will request information from each controller in a specified order. All other controllers listen on the line for information required to perform their operations.

DTC PARAMETERS

This DTC will set anytime the BPM has requested information from the instrument panel control (IPC) and the IPC did not respond for 10 seconds.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Other serial data DTCs.

TELLTALE ILLUMINATED

None

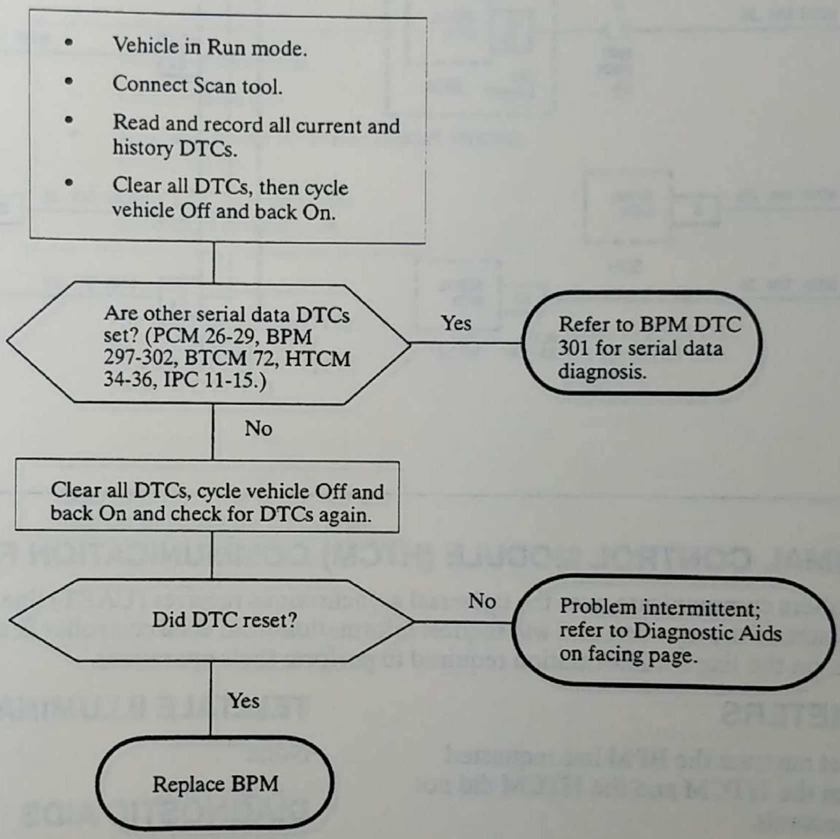
DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

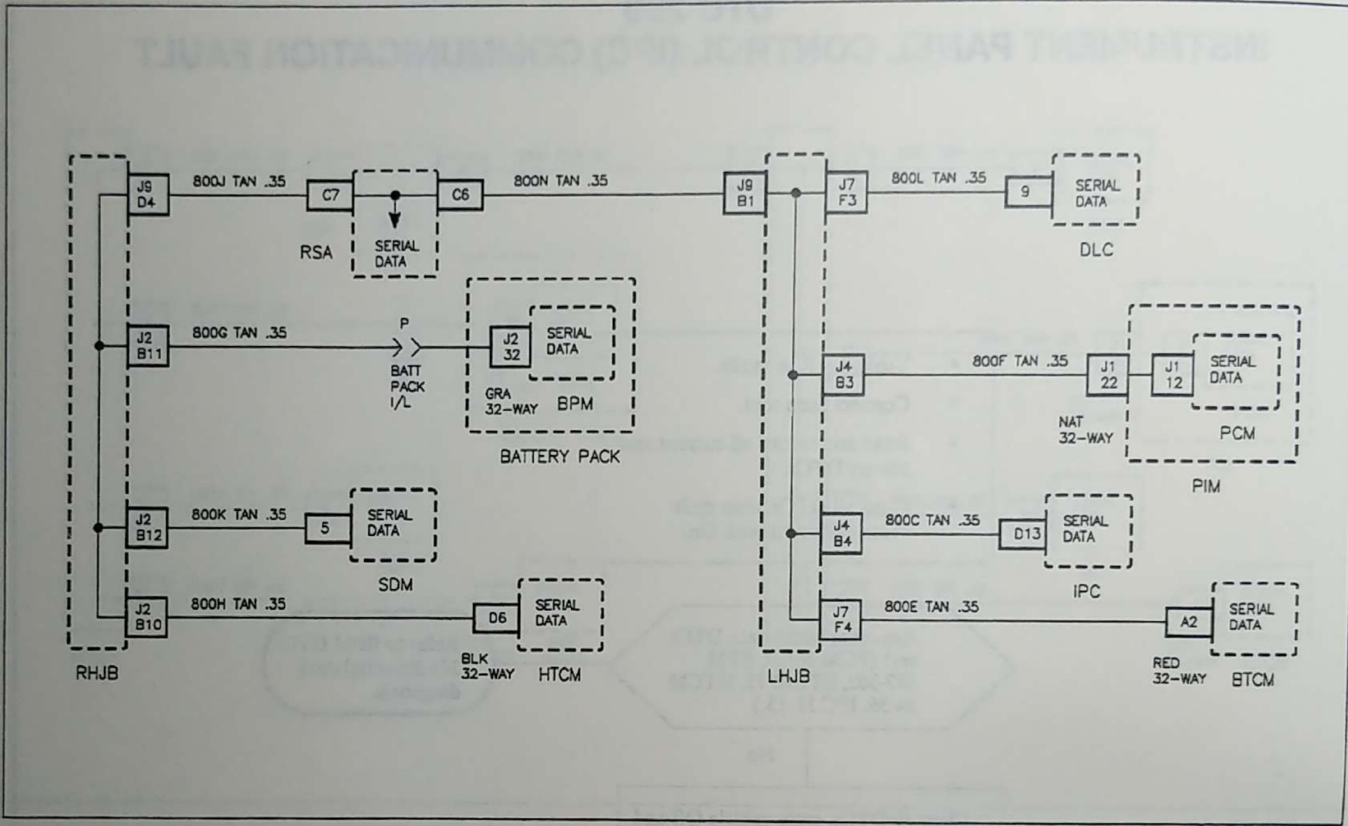
Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

DTC 299
INSTRUMENT PANEL CONTROL (IPC) COMMUNICATION FAULT


Vehicle in Run mode.
Connect Scan tool.
Read and record all current and history DTCs.
Clear all DTCs, then cycle vehicle Off and back On.
Are other serial data DTCs set? (PCM 26-29, BPM 297-302, BTCM 72, HTCM 34-36, IPC 11-15.)
Yes
Refer to BPM DTC 301 for serial data diagnosis.
No
Clear all DTCs, cycle vehicle Off and back On and check for DTCs again.
Did DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Replace BPM

DTC 300 – HPVS/THERMAL CONTROL MODULE (HTCM) COMMUNICATION FAULT


J9
D4
800J TAN .35
C7
C6
800N TAN .35
J9
B1
J7
F3
800L TAN .35
9
SERIAL
DATA
DLC
RSA
SERIAL
DATA
J2
B11
800G TAN .35
P
BATT
PACK
I/L
J2
32
SERIAL
DATA
GRA
32–WAY
BPM
BATTERY PACK
J4
B3
800F TAN .35
J1
22
J1
12
SERIAL
DATA
NAT
32–WAY
PCM
PIM
J2
B12
800K TAN .35
5
SERIAL
DATA
SDM
J4
B4
800C TAN .35
D13
SERIAL
DATA
IPC
J2
B10
800H TAN .35
D6
SERIAL
DATA
BLK
32–WAY
HTCM
RHJB
LHJB
J7
F4
800E TAN .35
A2
SERIAL
DATA
RED
32–WAY
BTCM

PSMELC68207AA

HPVS/THERMAL CONTROL MODULE (HTCM) COMMUNICATION FAULT

All of the controllers communicate over the universal asynchronous receiver (UART) line. The battery pack module (BPM) is the master of the uart line and will request information from each controller in a specified order. All other controllers listen on the line for information required to perform their operations.

DTC PARAMETERS

This DTC will set anytime the BPM has requested information from the HTCM and the HTCM did not respond for 10 seconds.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Other serial data DTCs.

TELLTALE ILLUMINATED

None

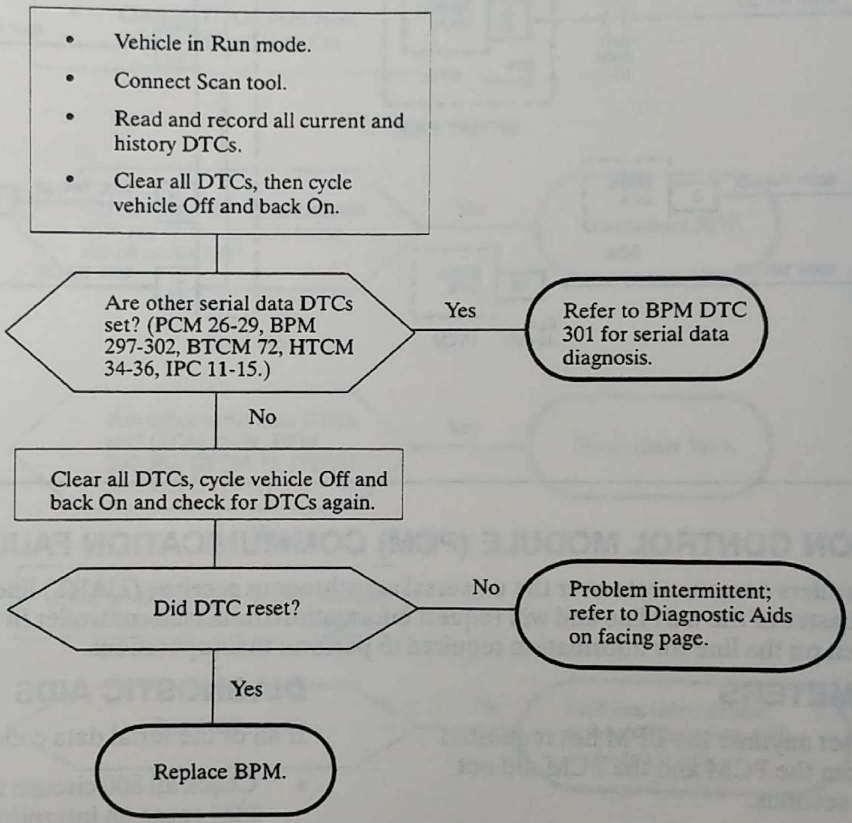
DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

DTC 300
HPVS/THERMAL CONTROL MODULE (HTCM) COMMUNICATION FAULT



- Vehicle in Run mode.
- Connect Scan tool.
- Read and record all current and history DTCs.
- Clear all DTCs, then cycle vehicle Off and back On.

Are other serial data DTCs set? (PCM 26-29, BPM 297-302, BTCM 72, HTCM 34-36, IPC 11-15.)

Refer to BPM DTC 301 for serial data diagnosis.

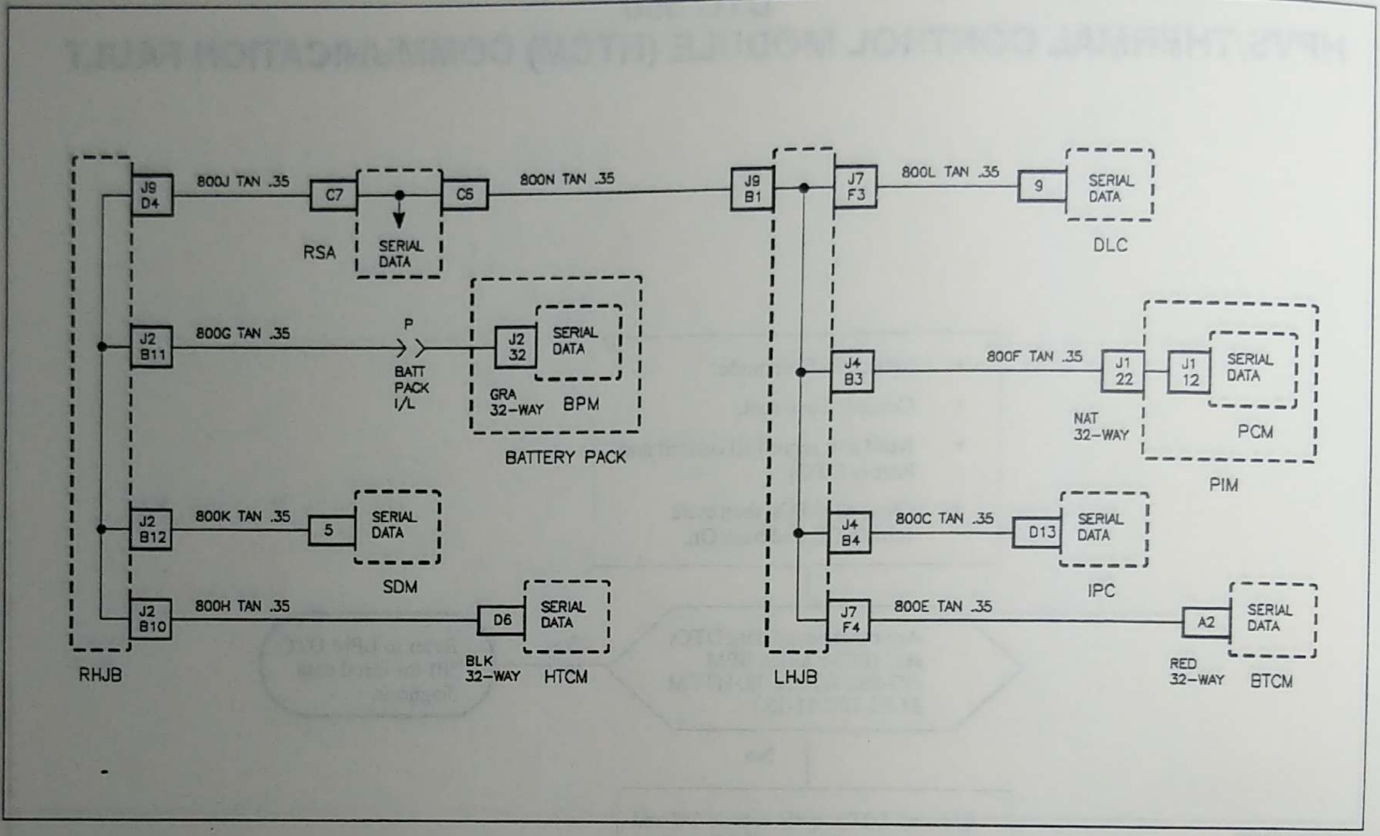
Clear all DTCs, cycle vehicle Off and back On and check for DTCs again.

Did DTC reset?

Problem intermittent; refer to Diagnostic Aids on facing page.

Replace BPM.

DTC 301 – PROPULSION CONTROL MODULE (PCM) COMMUNICATION FAULT


J9
D4
800J TAN .35
C7
RSA
SERIAL DATA
C6
800N TAN .35
J9
B1
J7
F3
800L TAN .35
9
SERIAL DATA
DLC
J2
B11
800G TAN .35
P
BATT PACK I/L
J2
32
SERIAL DATA
GRA 32–WAY
BPM
BATTERY PACK
J4
B3
800F TAN .35
J1
22
J1
12
SERIAL DATA
NAT 32–WAY
PCM
PIM
J2
B12
800K TAN .35
5
SERIAL DATA
SDM
J4
B4
800C TAN .35
D13
SERIAL DATA
IPC
J2
B10
800H TAN .35
D6
SERIAL DATA
BLK 32–WAY
HTCM
RHJB
LHJB
J7
F4
800E TAN .35
A2
SERIAL DATA
RED 32–WAY
BTCM

PSMELC68207AA

PROPULSION CONTROL MODULE (PCM) COMMUNICATION FAULT

All of the controllers communicate over the universal asynchronous receiver (UART) line. The battery pack module (BPM) is the master of the uart line and will request information from each controller in a specified order. All other controllers listen on the line for information required to perform their operations.

DTC PARAMETERS

This DTC will set anytime the BPM has requested information from the PCM and the PCM did not respond for 10 seconds.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Other serial data DTCs.

TELLTALE ILLUMINATED:

None

DIAGNOSTIC AIDS

If all of the serial data codes are set in history:

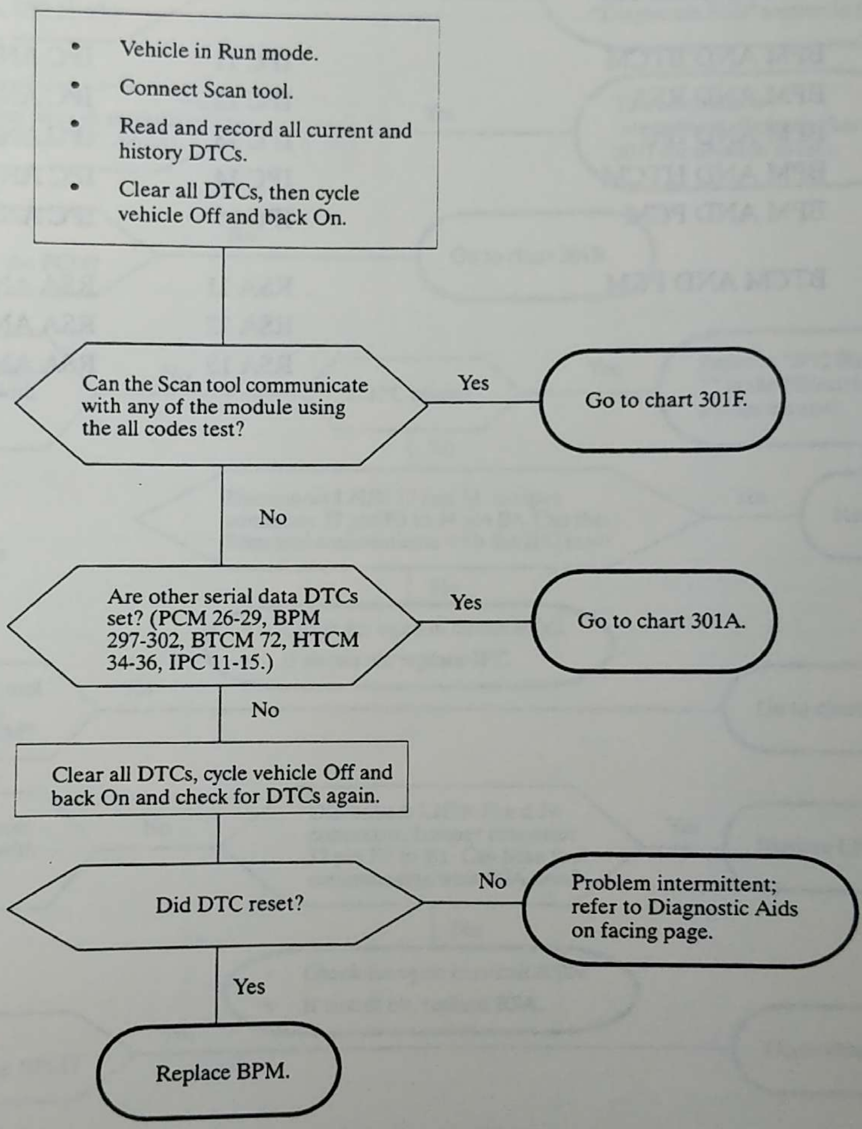
- Check all 800 circuits for chaffing or pinching that may cause an intermittent short to ground.
- Check circuit 800 G for intermittent open.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

DTC 301
PCM COMMUNICATION FAULT


Vehicle in Run mode.
Connect Scan tool.
Read and record all current and history DTCs.
Clear all DTCs, then cycle vehicle Off and back On.
Can the Scan tool communicate with any of the module using the all codes test?
Yes
Go to chart 301F.
No
Are other serial data DTCs set? (PCM 26-29, BPM 297-302, BTCM 72, HTCM 34-36, IPC 11-15.)
Yes
Go to chart 301A.
No
Clear all DTCs, cycle vehicle Off and back On and check for DTCs again.
Did DTC reset?
No
Problem intermittent; refer to Diagnostic Aids on facing page.
Yes
Replace BPM.

DTC/MODULES TABLE

DTC	COMMUNICATION BETWEEN
PCM 26	PCM AND BPM
PCM 27	PCM AND BTCM
PCM 28	PCM AND RSA
PCM 29	PCM AND HTCM
BPM 297	BPM AND BTCM
BPM 298	BPM AND RSA
BPM 299	BPM AND IPC
BPM 300	BPM AND HTCM
BPM 301	BPM AND PCM
BTCM 72	BTCM AND PCM
HTCM 34	HTCM AND RSA
HTCM 35	HTCM AND PCM
HTCM 36	HTCM AND BPM
IPC 11	IPC AND BPM
IPC 12	IPC AND PCM
IPC 13	IPC AND HTCM
IPC 14	IPC AND RSA
IPC 15	IPC AND BTCM
RSA 11	RSA AND BTCM
RSA 12	RSA AND HTCM
RSA 13	RSA AND PCM

CS CamScanner

DTC 301A

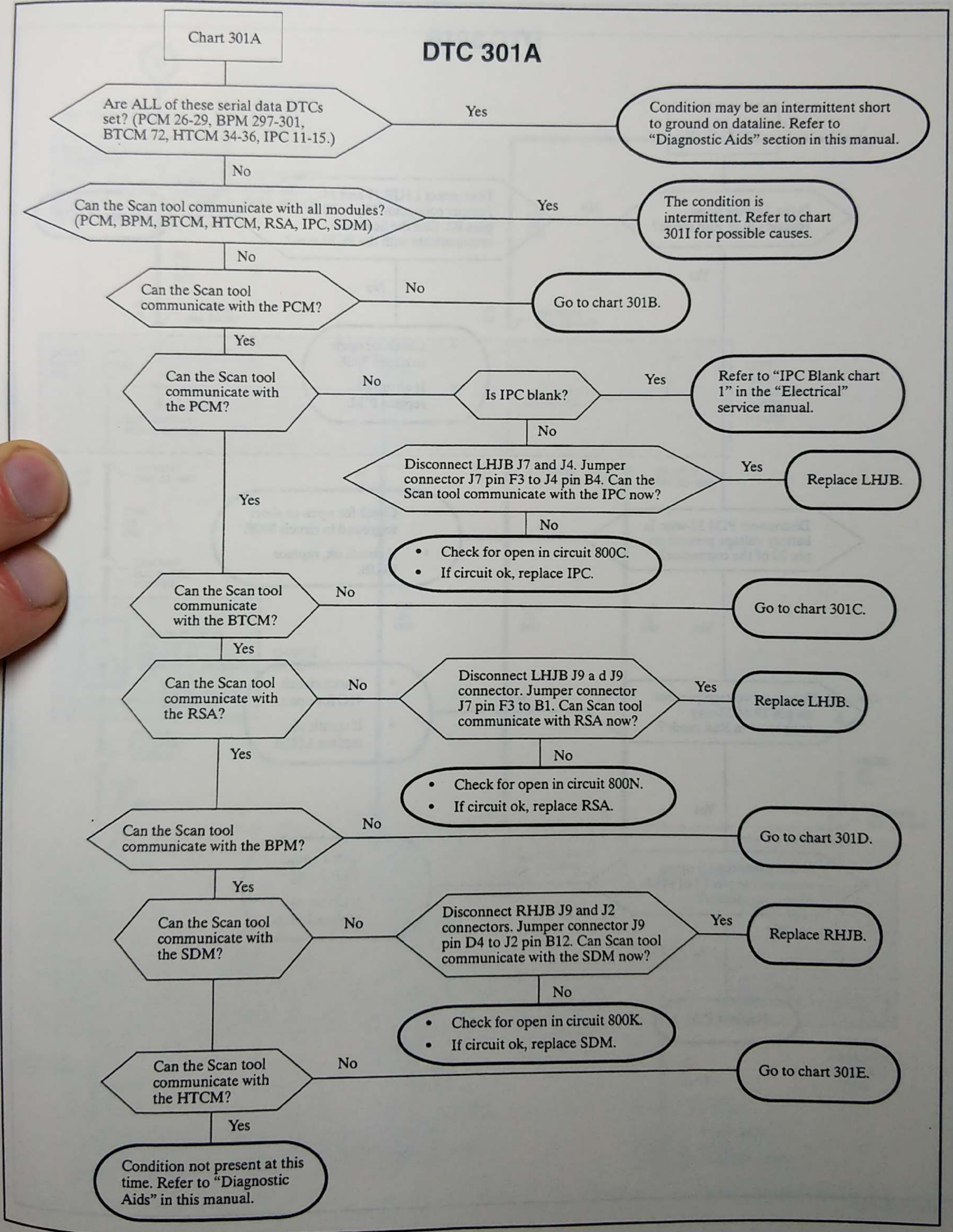


Chart 301A
Are ALL of these serial data DTCs set? (PCM 26-29, BPM 297-301, BTCM 72, HTCM 34-36, IPC 11-15.)
Yes
Condition may be an intermittent short to ground on dataline. Refer to "Diagnostic Aids" section in this manual.
No
Can the Scan tool communicate with all modules? (PCM, BPM, BTCM, HTCM, RSA, IPC, SDM)
Yes
The condition is intermittent. Refer to chart 301I for possible causes.
No
Can the Scan tool communicate with the PCM?
No
Go to chart 301B.
Yes
Can the Scan tool communicate with the PCM?
No
Is IPC blank?
Yes
Refer to "IPC Blank chart 1" in the "Electrical" service manual.
No
Disconnect LHJB J7 and J4. Jumper connector J7 pin F3 to J4 pin B4. Can the Scan tool communicate with the IPC now?
Yes
Replace LHJB.
No
• Check for open in circuit 800C.
• If circuit ok, replace IPC.
Yes
Can the Scan tool communicate with the BTCM?
No
Go to chart 301C.
Yes
Can the Scan tool communicate with the RSA?
No
Disconnect LHJB J9 a d J9 connector. Jumper connector J7 pin F3 to B1. Can Scan tool communicate with RSA now?
Yes
Replace LHJB.
No
• Check for open in circuit 800N.
• If circuit ok, replace RSA.
Yes
Can the Scan tool communicate with the BPM?
No
Go to chart 301D.
Yes
Can the Scan tool communicate with the SDM?
No
Disconnect RHJB J9 and J2 connectors. Jumper connector J9 pin D4 to J2 pin B12. Can Scan tool communicate with the SDM now?
Yes
Replace RHJB.
No
• Check for open in circuit 800K.
• If circuit ok, replace SDM.
Can the Scan tool communicate with the HTCM?
No
Go to chart 301E.
Yes
Condition not present at this time. Refer to "Diagnostic Aids" in this manual.

DTC 301B

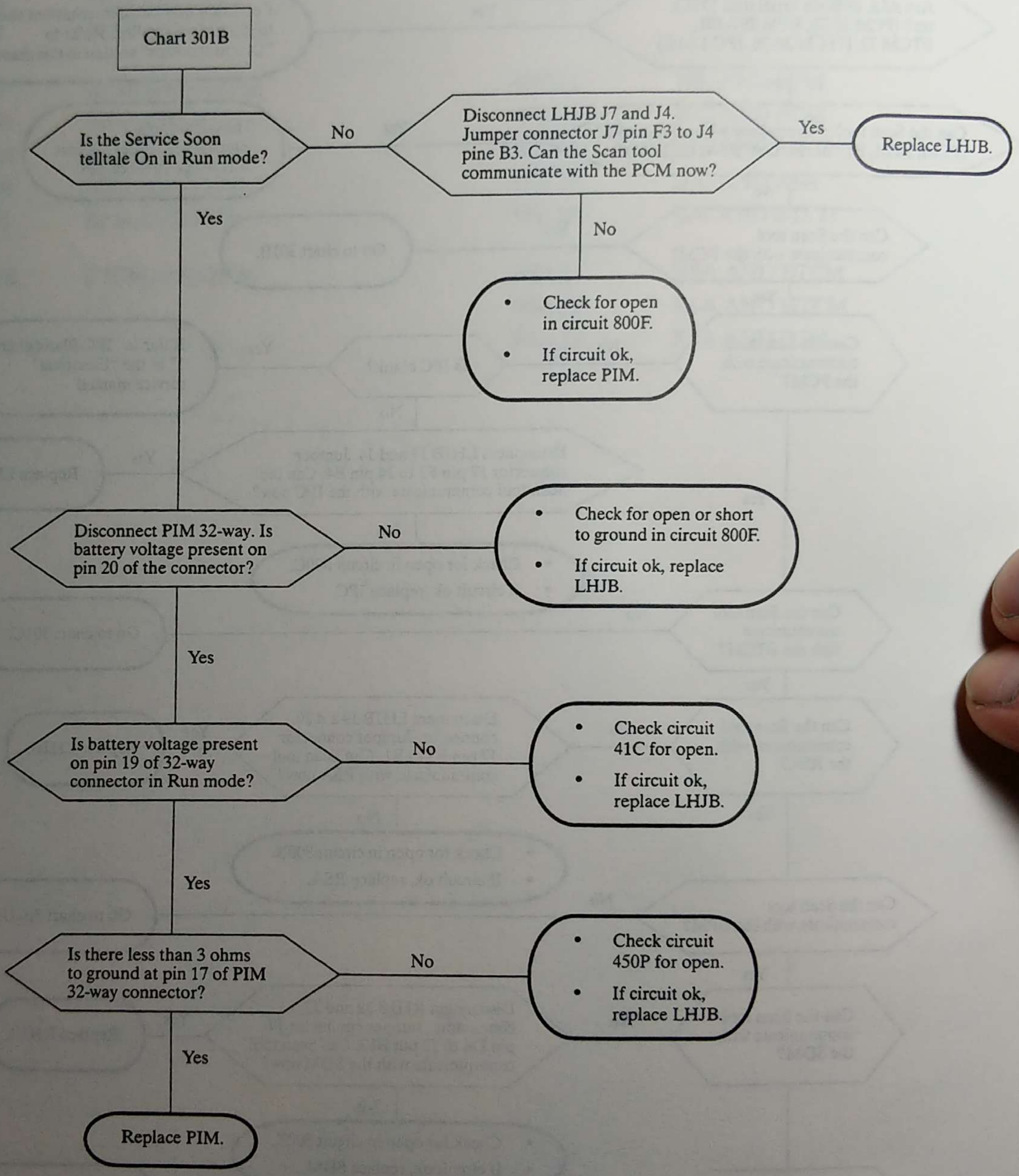


Chart 301B
Is the Service Soon telltale On in Run mode?
No
Disconnect LHJB J7 and J4. Jumper connector J7 pin F3 to J4 pine B3. Can the Scan tool communicate with the PCM now?
Yes
Replace LHJB.
No
• Check for open in circuit 800F.
• If circuit ok, replace PIM.
Yes
Disconnect PIM 32-way. Is battery voltage present on pin 20 of the connector?
No
• Check for open or short to ground in circuit 800F.
• If circuit ok, replace LHJB.
Yes
Is battery voltage present on pin 19 of 32-way connector in Run mode?
No
• Check circuit 41C for open.
• If circuit ok, replace LHJB.
Yes
Is there less than 3 ohms to ground at pin 17 of PIM 32-way connector?
No
• Check circuit 450P for open.
• If circuit ok, replace LHJB.
Yes
Replace PIM.

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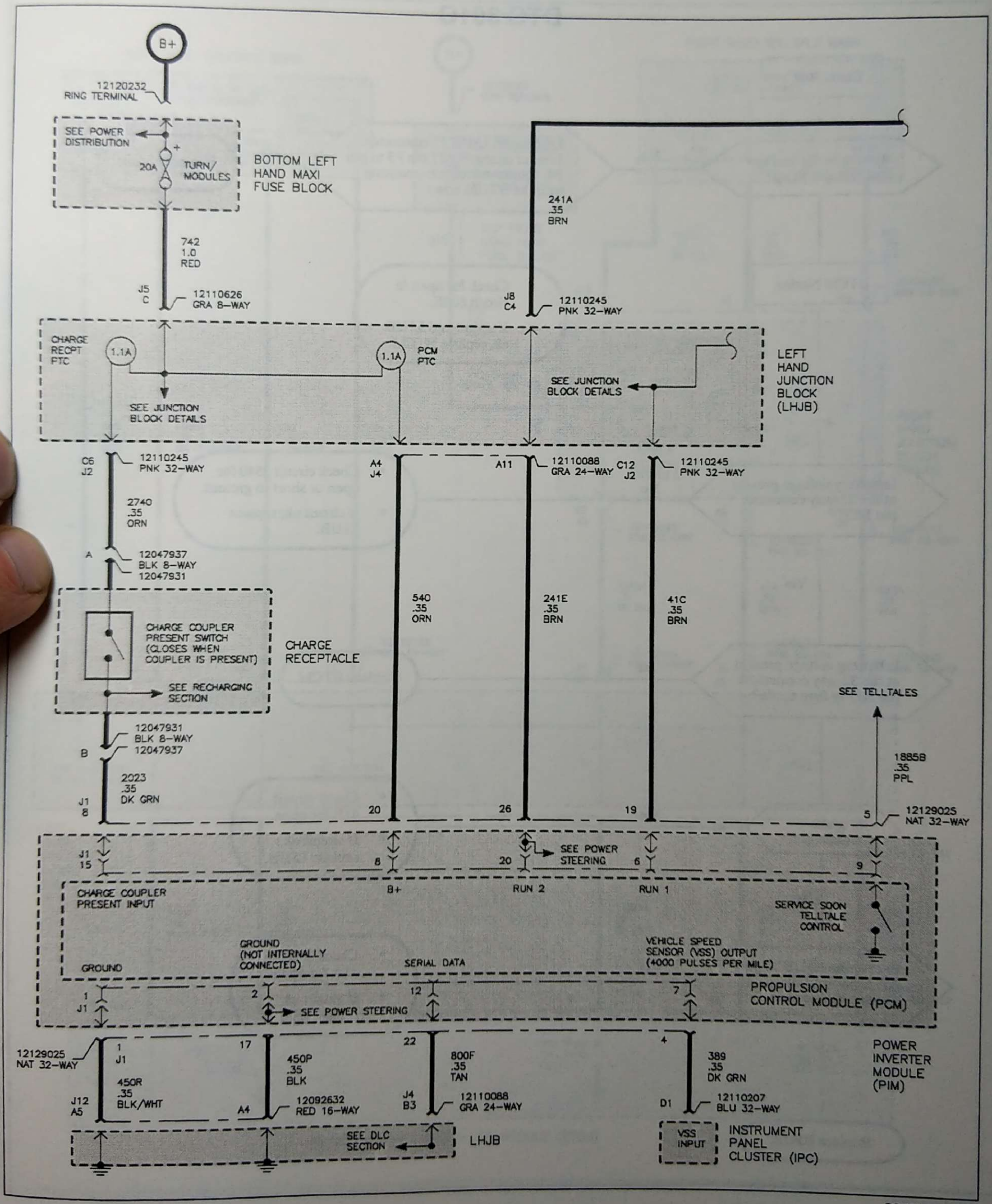
PROPULSION (LOW VOLTAGE)


B+
12120232
RING TERMINAL
SEE POWER DISTRIBUTION
20A
TURN/ MODULES
BOTTOM LEFT HAND MAXI FUSE BLOCK
742
1.0
RED
J5
C
12110626
GRA 8–WAY
241A
.35
BRN
J8
C4
12110245
PNK 32–WAY
CHARGE RECPT PTC
1.1A
1.1A
PCM PTC
SEE JUNCTION BLOCK DETAILS
SEE JUNCTION BLOCK DETAILS
LEFT HAND JUNCTION BLOCK (LHJB)
C6
J2
12110245
PNK 32–WAY
A4
J4
A11
12110088
GRA 24–WAY
C12
J2
12110245
PNK 32–WAY
2740
.35
ORN
A
12047937
BLK 8–WAY
12047931
540
.35
ORN
241E
.35
BRN
41C
.35
BRN
CHARGE COUPLER PRESENT SWITCH (CLOSES WHEN COUPLER IS PRESENT)
SEE RECHARGING SECTION
CHARGE RECEPTACLE
SEE TELLTALES
12047931
BLK 8–WAY
12047937
B
2023
.35
DK GRN
J1
8
20
26
19
1885B
.35
PPL
5
12129025
NAT 32–WAY
J1
15
8
20
SEE POWER STEERING
6
9
B+
RUN 2
RUN 1
CHARGE COUPLER PRESENT INPUT
SERVICE SOON TELLTALE CONTROL
GROUND (NOT INTERNALLY CONNECTED)
SERIAL DATA
VEHICLE SPEED SENSOR (VSS) OUTPUT (4000 PULSES PER MILE)
GROUND
1
J1
2
SEE POWER STEERING
12
7
PROPULSION CONTROL MODULE (PCM)
12129025
NAT 32–WAY
1
J1
17
22
4
POWER INVERTER MODULE (PIM)
450R
.35
BLK/WHT
450P
.35
BLK
800F
.35
TAN
389
.35
DK GRN
J12
A5
A4
12092632
RED 16–WAY
J4
B3
12110088
GRA 24–WAY
D1
12110207
BLU 32–WAY
SEE DLC SECTION
LHJB
VSS INPUT
INSTRUMENT PANEL CLUSTER (IPC)

PSMELC67644AB

DTC 301C

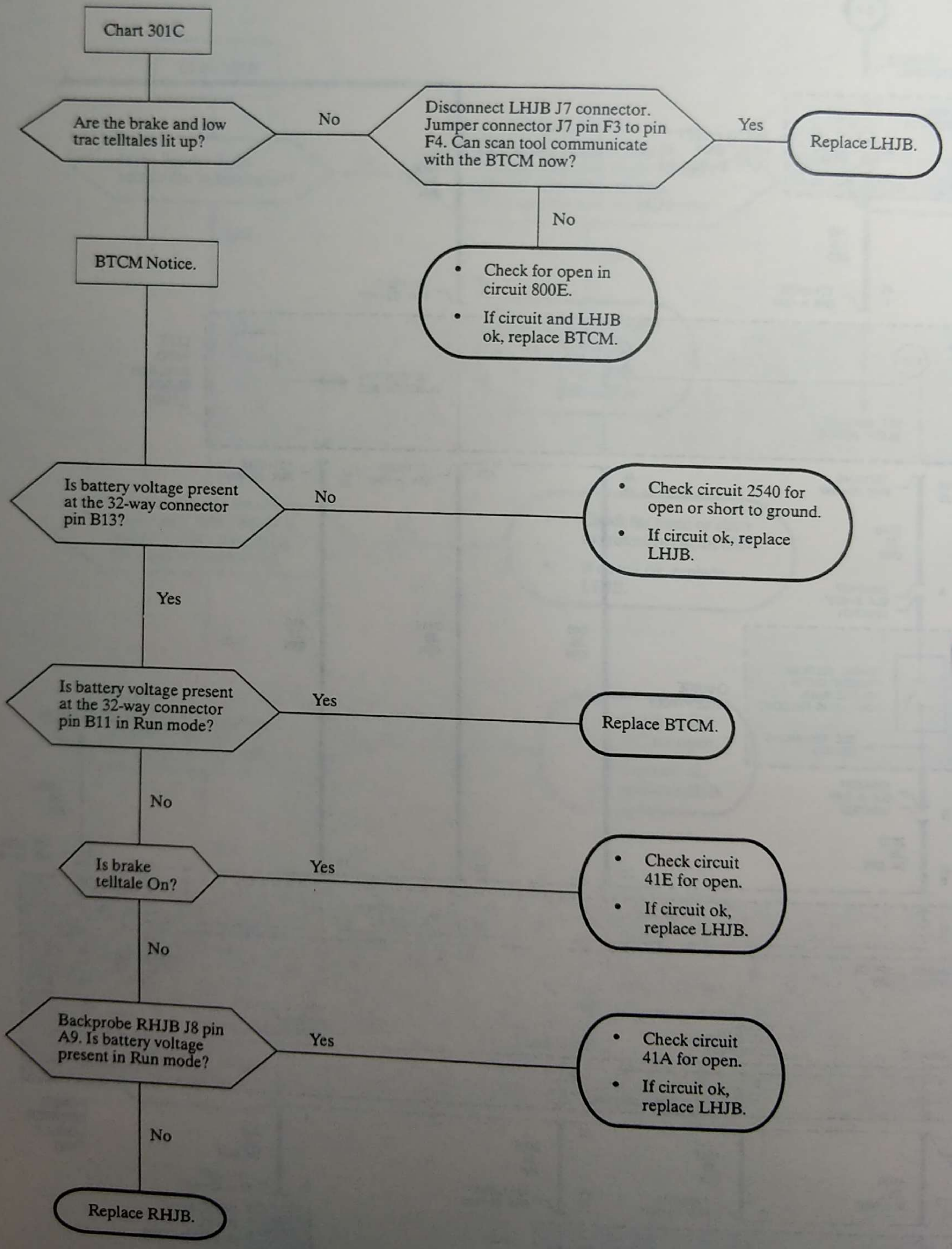
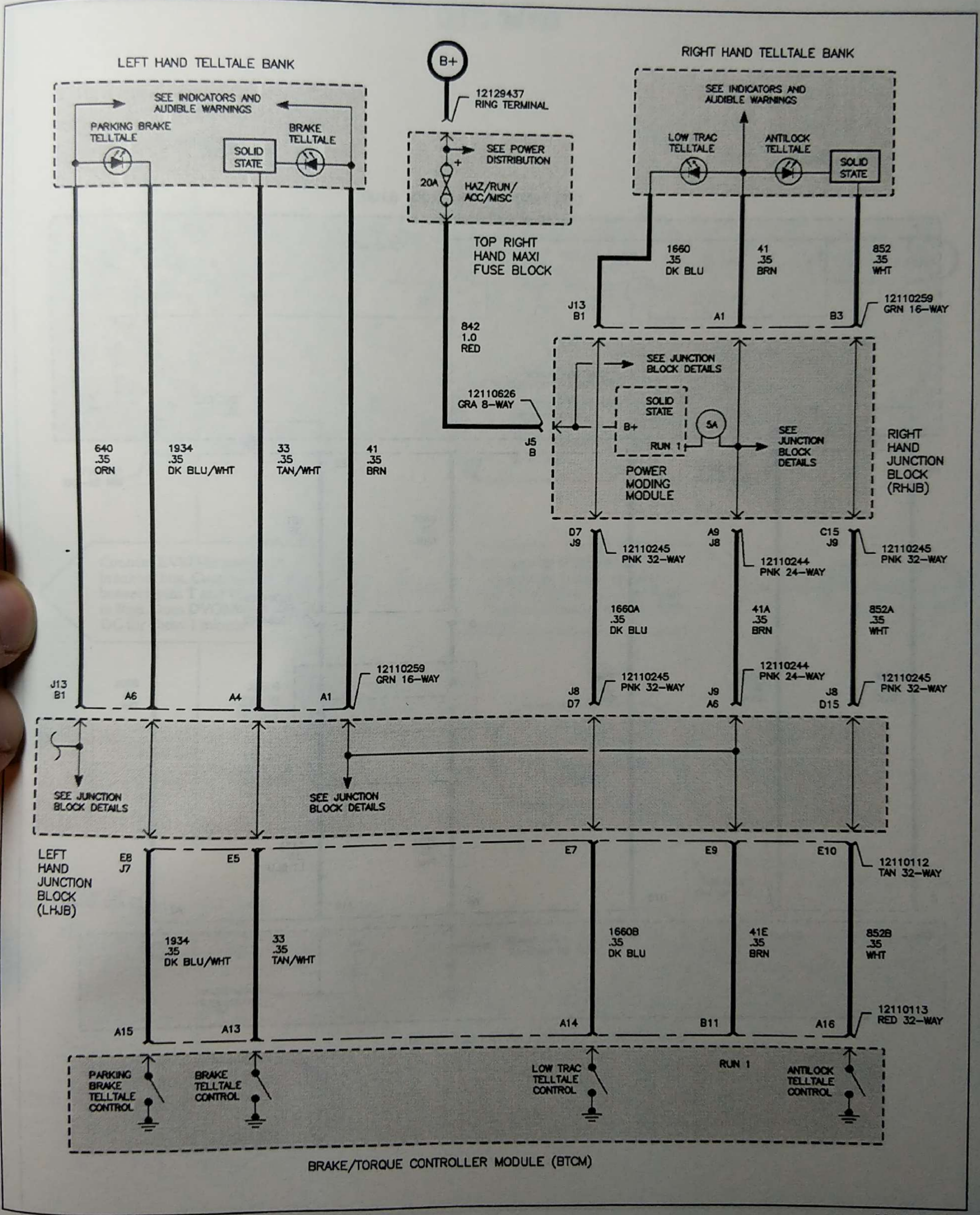


Chart 301C
Are the brake and low trac telltales lit up?
No
Disconnect LHJB J7 connector. Jumper connector J7 pin F3 to pin F4. Can scan tool communicate with the BTCM now?
Yes
Replace LHJB.
No
• Check for open in circuit 800E.
• If circuit and LHJB ok, replace BTCM.
BTCM Notice.
Is battery voltage present at the 32-way connector pin B13?
No
• Check circuit 2540 for open or short to ground.
• If circuit ok, replace LHJB.
Yes
Is battery voltage present at the 32-way connector pin B11 in Run mode?
Yes
Replace BTCM.
No
Is brake telltale On?
Yes
• Check circuit 41E for open.
• If circuit ok, replace LHJB.
No
Backprobe RHJB J8 pin A9. Is battery voltage present in Run mode?
Yes
• Check circuit 41A for open.
• If circuit ok, replace LHJB.
No
Replace RHJB.


LEFT HAND TELLTALE BANK
SEE INDICATORS AND AUDIBLE WARNINGS
PARKING BRAKE TELLTALE
SOLID STATE
BRAKE TELLTALE
B+
12129437 RING TERMINAL
SEE POWER DISTRIBUTION
20A
HAZ/RUN/ACC/MISC
TOP RIGHT HAND MAXI FUSE BLOCK
842 1.0 RED
12110626 GRA 8-WAY
J5 B
RIGHT HAND TELLTALE BANK
SEE INDICATORS AND AUDIBLE WARNINGS
LOW TRAC TELLTALE
ANTILOCK TELLTALE
SOLID STATE
1660 .35 DK BLU
41 .35 BRN
852 .35 WHT
12110259 GRN 16-WAY
J13 B1
A1
B3
SEE JUNCTION BLOCK DETAILS
SOLID STATE
B+
RUN 1
5A
SEE JUNCTION BLOCK DETAILS
POWER MODING MODULE
RIGHT HAND JUNCTION BLOCK (RHJB)
D7 J9
12110245 PNK 32-WAY
A9 J8
12110244 PNK 24-WAY
C15 J9
12110245 PNK 32-WAY
1660A .35 DK BLU
41A .35 BRN
852A .35 WHT
12110245 PNK 32-WAY
J8 D7
12110244 PNK 24-WAY
J9 A6
12110245 PNK 32-WAY
J8 D15
640 .35 ORN
1934 .35 DK BLU/WHT
33 .35 TAN/WHT
41 .35 BRN
12110259 GRN 16-WAY
J13 B1
A6
A4
A1
SEE JUNCTION BLOCK DETAILS
SEE JUNCTION BLOCK DETAILS
LEFT HAND JUNCTION BLOCK (LHJB)
E8 J7
E5
E7
E9
E10
12110112 TAN 32-WAY
1934 .35 DK BLU/WHT
33 .35 TAN/WHT
1660B .35 DK BLU
41E .35 BRN
852B .35 WHT
A15
A13
A14
B11
A16
12110113 RED 32-WAY
PARKING BRAKE TELLTALE CONTROL
BRAKE TELLTALE CONTROL
LOW TRAC TELLTALE CONTROL
RUN 1
ANTILOCK TELLTALE CONTROL
BRAKE/TORQUE CONTROLLER MODULE (BTCM)

PSMELC67470AA

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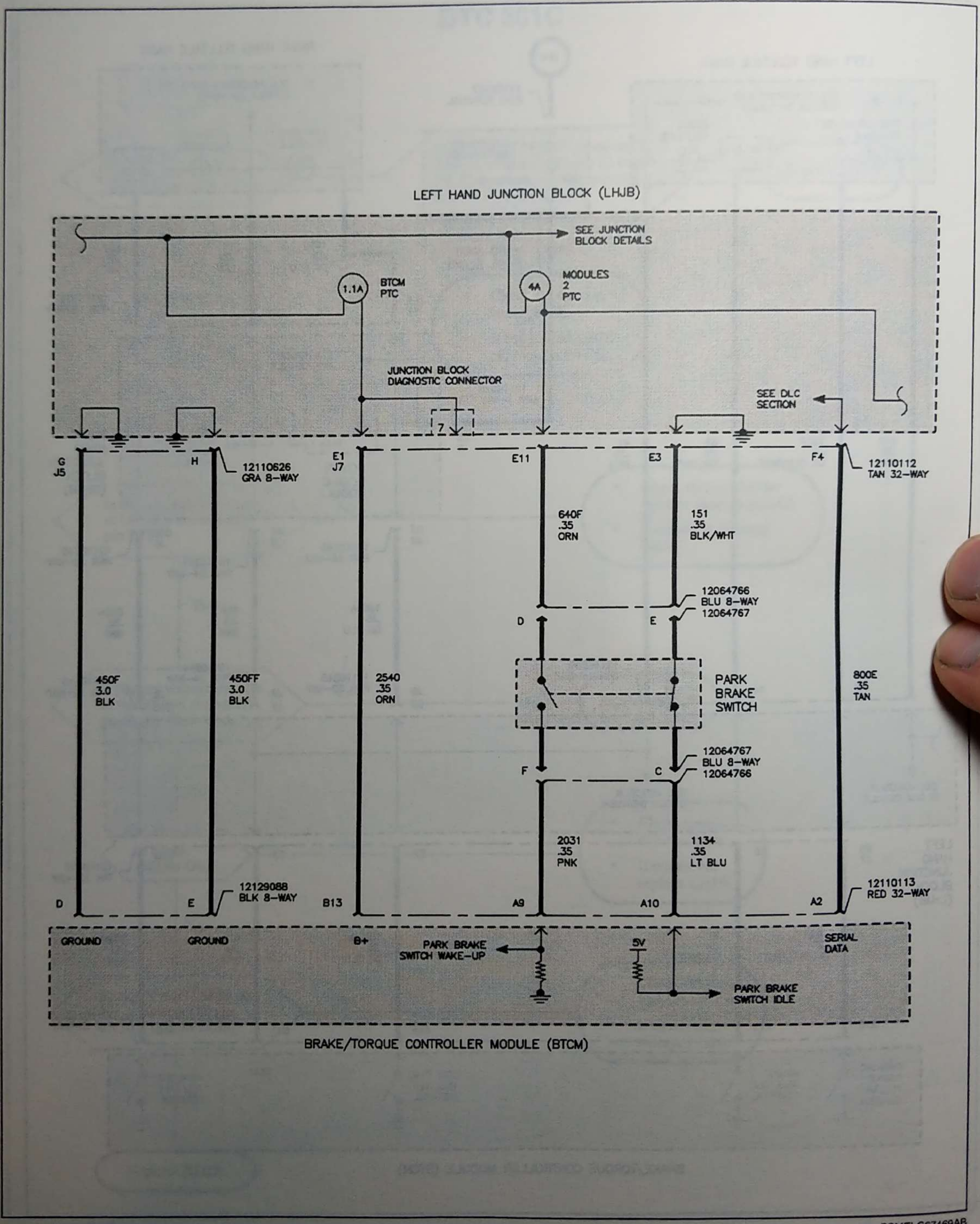

LEFT HAND JUNCTION BLOCK (LHJB)
SEE JUNCTION BLOCK DETAILS
1.1A
BTCM PTC
4A
MODULES 2 PTC
JUNCTION BLOCK DIAGNOSTIC CONNECTOR
7
SEE DLC SECTION
G J5
H
12110626 GRA 8-WAY
E1 J7
E11
E3
F4
12110112 TAN 32-WAY
640F .35 ORN
151 .35 BLK/WHT
12064766 BLU 8-WAY 12064767
D
E
450F 3.0 BLK
450FF 3.0 BLK
2540 .35 ORN
PARK BRAKE SWITCH
800E .35 TAN
12064767 BLU 8-WAY 12064766
F
C
2031 .35 PNK
1134 .35 LT BLU
12129088 BLK 8-WAY
12110113 RED 32-WAY
D
E
B13
A9
A10
A2
GROUND
GROUND
B+
PARK BRAKE SWITCH WAKE-UP
5V
PARK BRAKE SWITCH IDLE
SERIAL DATA
BRAKE/TORQUE CONTROLLER MODULE (BTCM)
PSMELC67469AB

DTC 301D

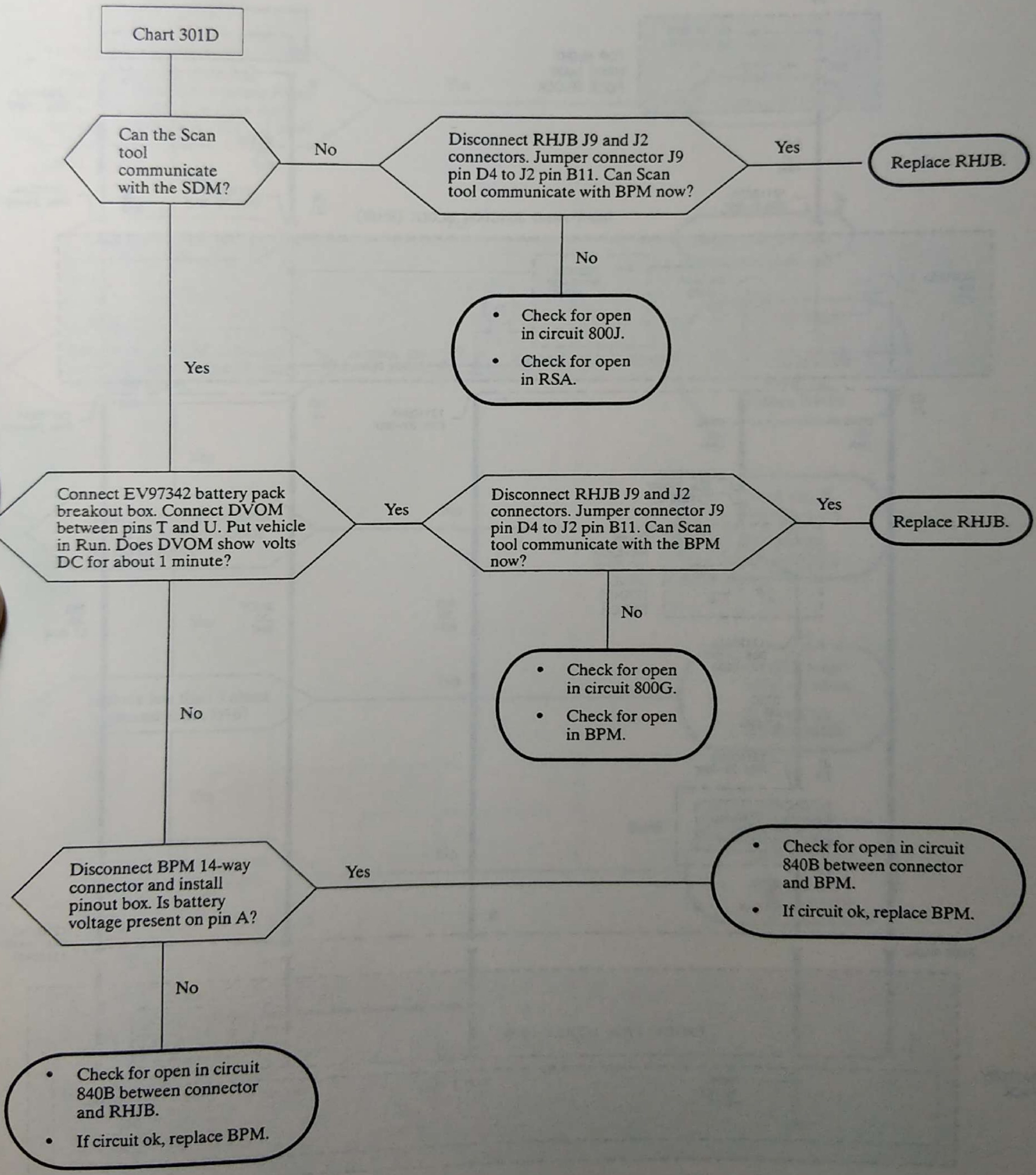
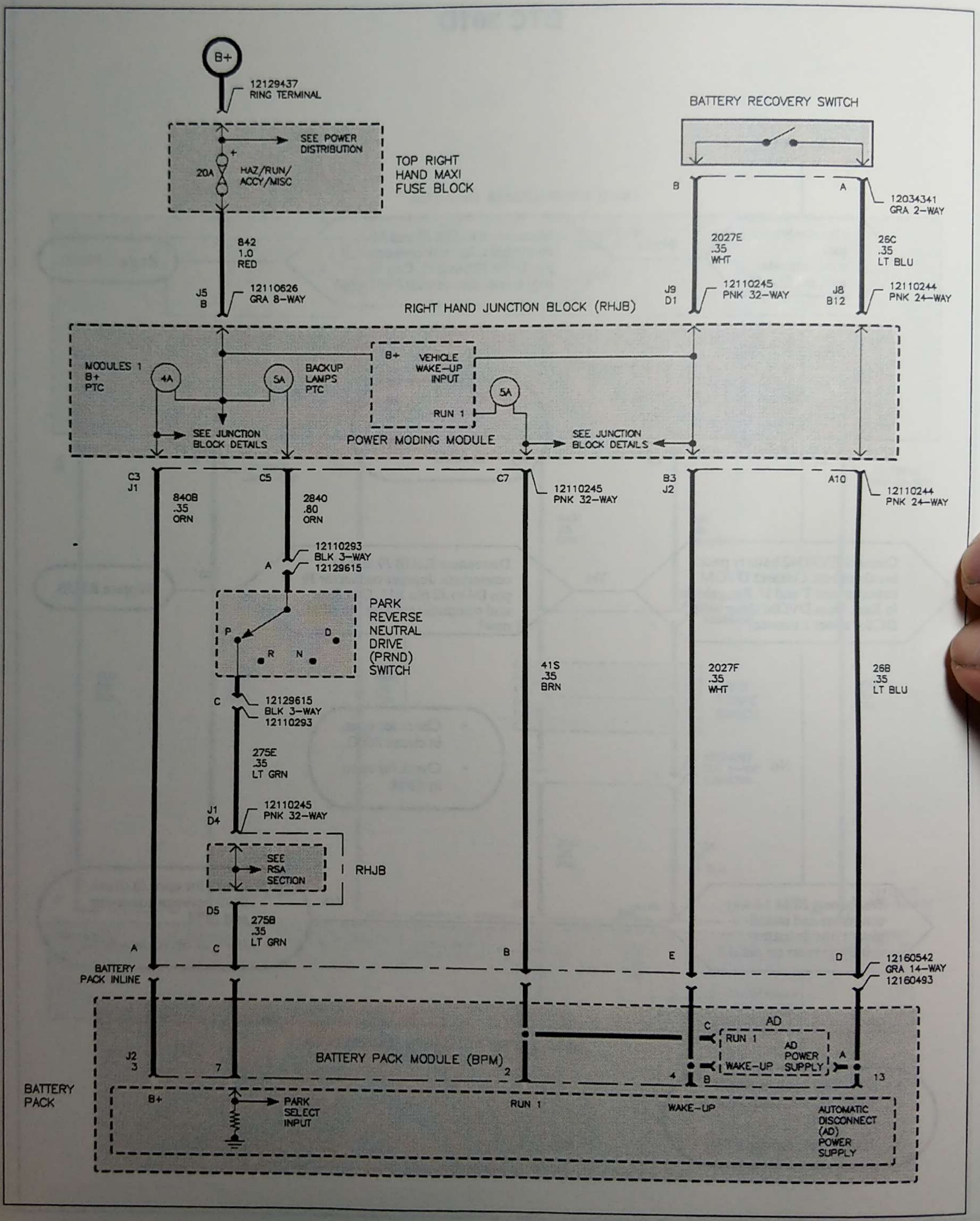


Chart 301D
Can the Scan tool communicate with the SDM?
No
Disconnect RHJB J9 and J2 connectors. Jumper connector J9 pin D4 to J2 pin B11. Can Scan tool communicate with BPM now?
Yes
Replace RHJB.
No
• Check for open in circuit 800J.
• Check for open in RSA.
Yes
Connect EV97342 battery pack breakout box. Connect DVOM between pins T and U. Put vehicle in Run. Does DVOM show volts DC for about 1 minute?
Yes
Disconnect RHJB J9 and J2 connectors. Jumper connector J9 pin D4 to J2 pin B11. Can Scan tool communicate with the BPM now?
Yes
Replace RHJB.
No
• Check for open in circuit 800G.
• Check for open in BPM.
No
Disconnect BPM 14-way connector and install pinout box. Is battery voltage present on pin A?
Yes
• Check for open in circuit 840B between connector and BPM.
• If circuit ok, replace BPM.
No
• Check for open in circuit 840B between connector and RHJB.
• If circuit ok, replace BPM.

BATTERY PACK (LOW VOLTAGE)


B+
12129437
RING TERMINAL
SEE POWER
DISTRIBUTION
20A
HAZ/RUN/
ACCY/MISC
TOP RIGHT
HAND MAXI
FUSE BLOCK
842
1.0
RED
J5
B
12110626
GRA 8–WAY
BATTERY RECOVERY SWITCH
B
A
12034341
GRA 2–WAY
2027E
.35
WHT
26C
.35
LT BLU
J9
D1
12110245
PNK 32–WAY
J8
B12
12110244
PNK 24–WAY
RIGHT HAND JUNCTION BLOCK (RHJB)
MODULES 1
B+
PTC
4A
5A
BACKUP
LAMPS
PTC
B+
VEHICLE
WAKE–UP
INPUT
RUN 1
5A
SEE JUNCTION
BLOCK DETAILS
POWER MODING MODULE
SEE JUNCTION
BLOCK DETAILS
C3
J1
C5
C7
12110245
PNK 32–WAY
B3
J2
A10
12110244
PNK 24–WAY
840B
.35
ORN
2840
.80
ORN
12110293
BLK 3–WAY
12129615
A
PARK
REVERSE
NEUTRAL
DRIVE
(PRND)
SWITCH
P
D
R
N
C
12129615
BLK 3–WAY
12110293
275E
.35
LT GRN
J1
D4
12110245
PNK 32–WAY
SEE
RSA
SECTION
RHJB
D5
275B
.35
LT GRN
41S
.35
BRN
2027F
.35
WHT
26B
.35
LT BLU
A
C
B
E
D
12160542
GRA 14–WAY
12160493
BATTERY
PACK INLINE
J2
3
7
BATTERY PACK MODULE (BPM)
2
AD
C
RUN 1
AD
POWER
SUPPLY
WAKE–UP
A
4
B
13
BATTERY
PACK
B+
PARK
SELECT
INPUT
RUN 1
WAKE–UP
AUTOMATIC
DISCONNECT
(AD)
POWER
SUPPLY

PSMELC68117AA

DTC 301E

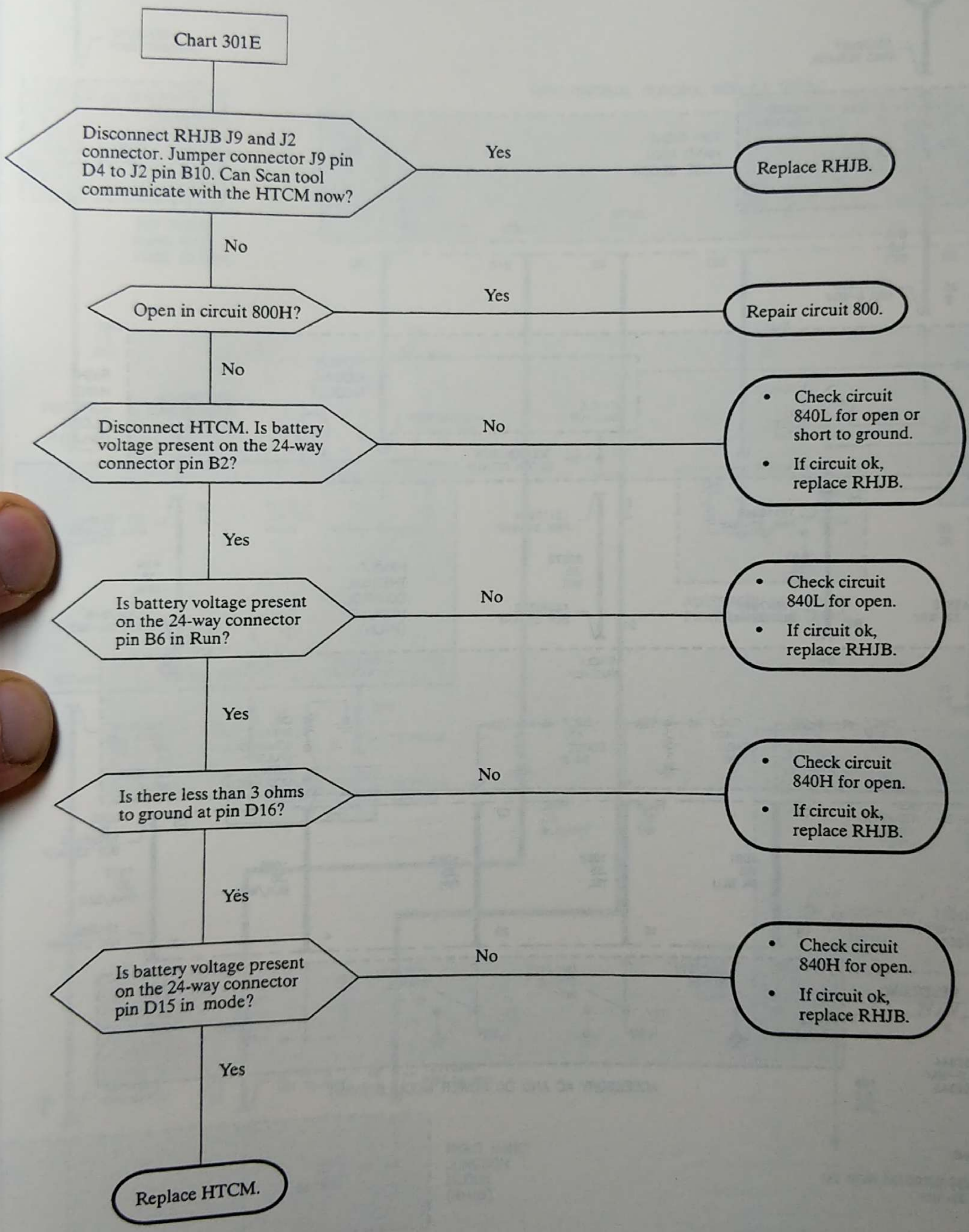
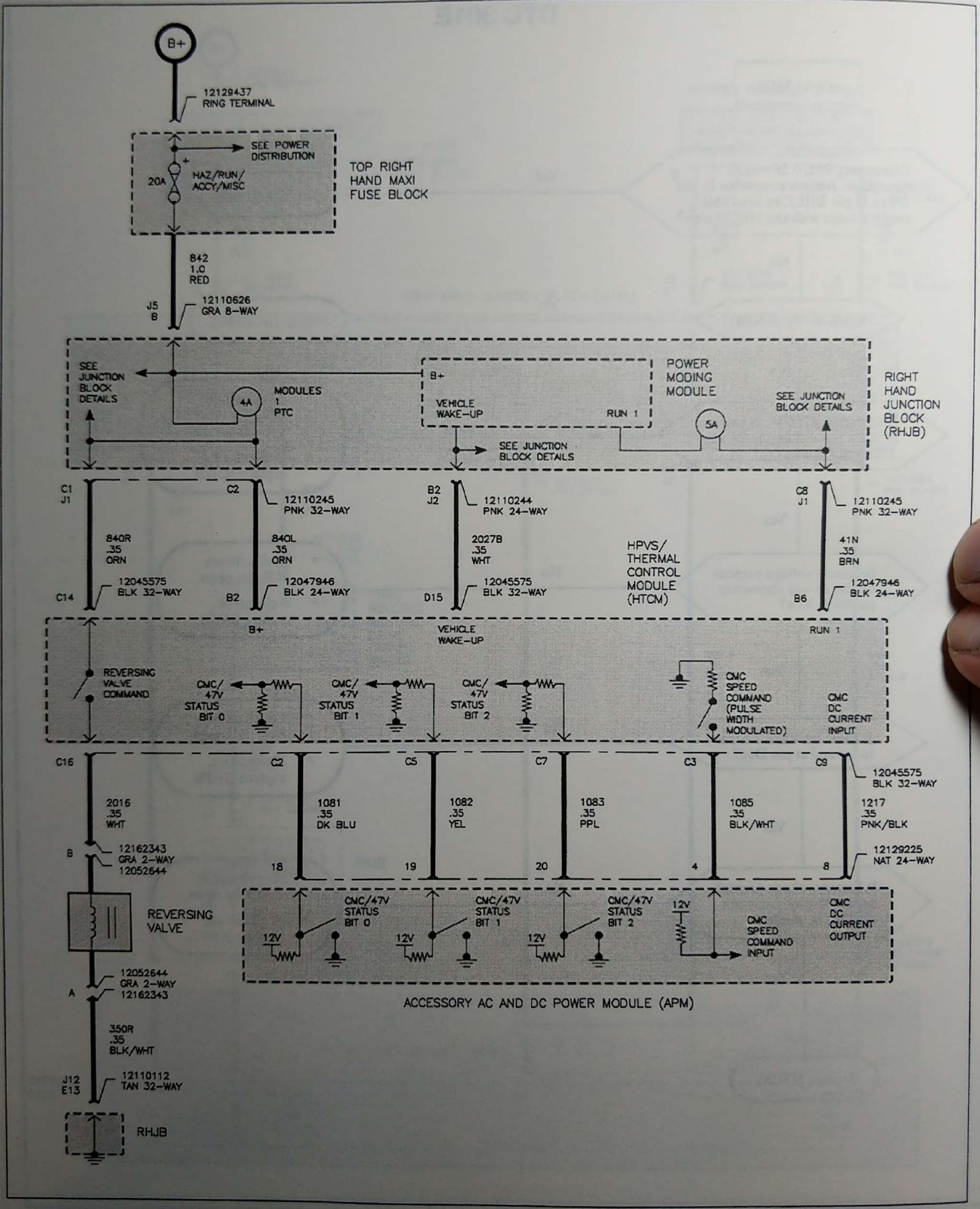
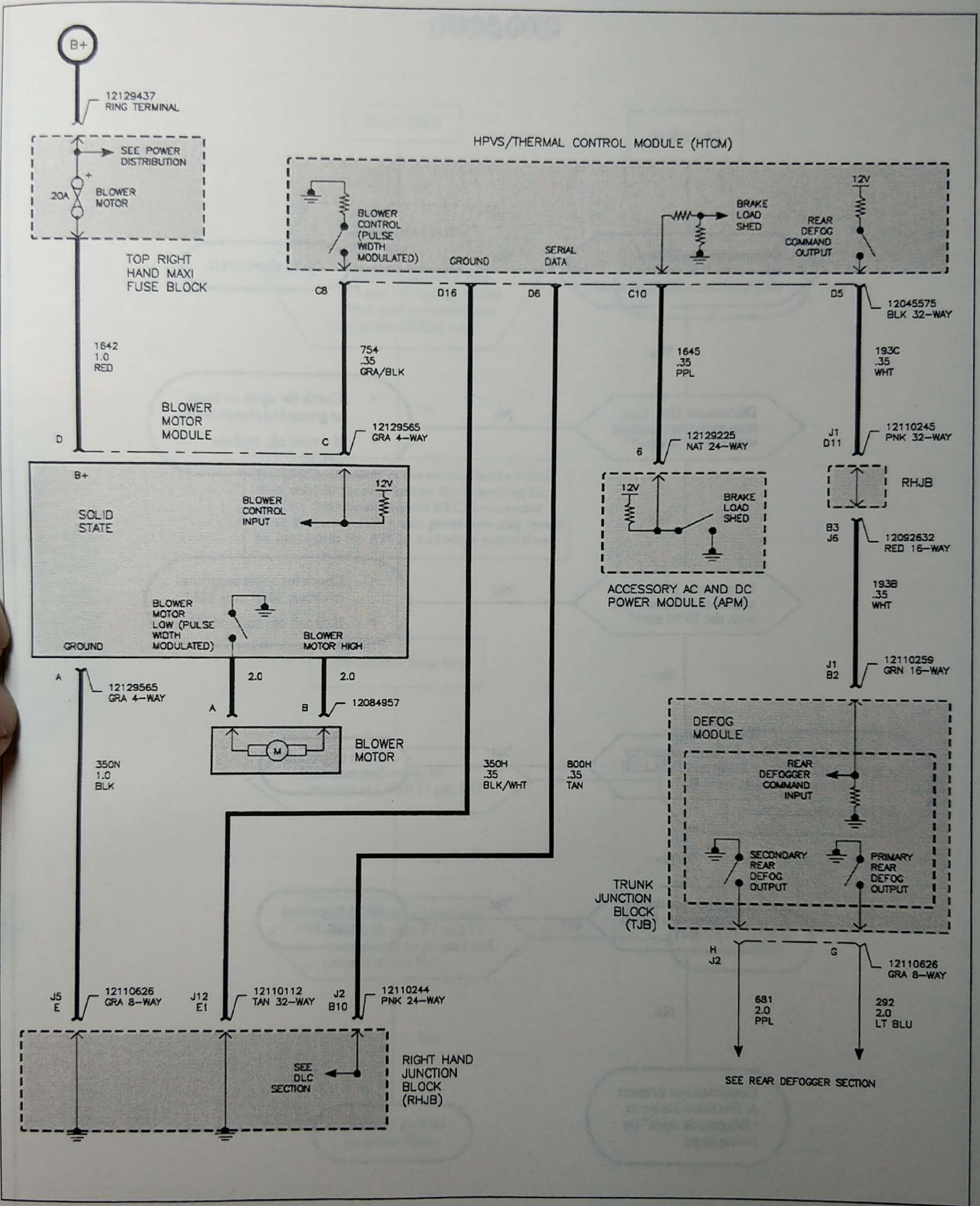


Chart 301E
Disconnect RHJB J9 and J2 connector. Jumper connector J9 pin D4 to J2 pin B10. Can Scan tool communicate with the HTCM now?
Yes
Replace RHJB.
No
Open in circuit 800H?
Yes
Repair circuit 800.
No
Disconnect HTCM. Is battery voltage present on the 24-way connector pin B2?
No
• Check circuit 840L for open or short to ground.
• If circuit ok, replace RHJB.
Yes
Is battery voltage present on the 24-way connector pin B6 in Run?
No
• Check circuit 840L for open.
• If circuit ok, replace RHJB.
Yes
Is there less than 3 ohms to ground at pin D16?
No
• Check circuit 840H for open.
• If circuit ok, replace RHJB.
Yes
Is battery voltage present on the 24-way connector pin D15 in mode?
No
• Check circuit 840H for open.
• If circuit ok, replace RHJB.
Yes
Replace HTCM.

CLIMATE CONTROL


B+
12129437
RING TERMINAL
SEE POWER DISTRIBUTION
20A
HAZ/RUN/ACCY/MISC
TOP RIGHT HAND MAXI FUSE BLOCK
842
1.0
RED
J5
B
12110626
GRA 8-WAY
SEE JUNCTION BLOCK DETAILS
4A
MODULES 1 PTC
B+
VEHICLE WAKE-UP
RUN 1
POWER MODING MODULE
SEE JUNCTION BLOCK DETAILS
5A
SEE JUNCTION BLOCK DETAILS
RIGHT HAND JUNCTION BLOCK (RHJB)
C1
J1
C2
12110245
PNK 32-WAY
B2
J2
12110244
PNK 24-WAY
C8
J1
12110245
PNK 32-WAY
840R
.35
ORN
840L
.35
ORN
2027B
.35
WHT
HPVS/THERMAL CONTROL MODULE (HTCM)
41N
.35
BRN
C14
12045575
BLK 32-WAY
B2
12047946
BLK 24-WAY
D15
12045575
BLK 32-WAY
B6
12047946
BLK 24-WAY
B+
VEHICLE WAKE-UP
RUN 1
REVERSING VALVE COMMAND
CMC/47V STATUS BIT 0
CMC/47V STATUS BIT 1
CMC/47V STATUS BIT 2
CMC SPEED COMMAND (PULSE WIDTH MODULATED)
CMC DC CURRENT INPUT
C16
C2
C5
C7
C3
C9
12045575
BLK 32-WAY
2016
.35
WHT
1081
.35
DK BLU
1082
.35
YEL
1083
.35
PPL
1085
.35
BLK/WHT
1217
.35
PNK/BLK
B
12162343
GRA 2-WAY
12052644
18
19
20
4
8
12129225
NAT 24-WAY
REVERSING VALVE
CMC/47V STATUS BIT 0
12V
CMC/47V STATUS BIT 1
12V
CMC/47V STATUS BIT 2
12V
12V
CMC SPEED COMMAND INPUT
CMC DC CURRENT OUTPUT
12052644
GRA 2-WAY
12162343
A
ACCESSORY AC AND DC POWER MODULE (APM)
350R
.35
BLK/WHT
J12
E13
12110112
TAN 32-WAY
RHJB

PSMELC68139AA


B+
12129437
RING TERMINAL
SEE POWER DISTRIBUTION
20A
BLOWER MOTOR
TOP RIGHT HAND MAXI FUSE BLOCK
1642
1.0
RED
HPVS/THERMAL CONTROL MODULE (HTCM)
BLOWER CONTROL (PULSE WIDTH MODULATED)
GROUND
SERIAL DATA
BRAKE LOAD SHED
12V
REAR DEFOG COMMAND OUTPUT
C8
D16
D6
C10
D5
12045575
BLK 32–WAY
754
.35
GRA/BLK
1645
.35
PPL
193C
.35
WHT
BLOWER MOTOR MODULE
D
C
12129565
GRA 4–WAY
12129225
NAT 24–WAY
6
J1
D11
12110245
PNK 32–WAY
B+
SOLID STATE
BLOWER CONTROL INPUT
12V
BLOWER MOTOR LOW (PULSE WIDTH MODULATED)
GROUND
BLOWER MOTOR HIGH
12V
BRAKE LOAD SHED
ACCESSORY AC AND DC POWER MODULE (APM)
RHJB
B3
J6
12092632
RED 16–WAY
193B
.35
WHT
J1
B2
12110259
GRN 16–WAY
A
12129565
GRA 4–WAY
2.0
2.0
A
B
12084957
BLOWER MOTOR
M
350N
1.0
BLK
350H
.35
BLK/WHT
800H
.35
TAN
DEFOG MODULE
REAR DEFOGGER COMMAND INPUT
SECONDARY REAR DEFOG OUTPUT
PRIMARY REAR DEFOG OUTPUT
TRUNK JUNCTION BLOCK (TJB)
H
J2
G
12110626
GRA 8–WAY
681
2.0
PPL
292
2.0
LT BLU
SEE REAR DEFOGGER SECTION
J5
E
12110626
GRA 8–WAY
J12
E1
12110112
TAN 32–WAY
J2
B10
12110244
PNK 24–WAY
SEE DLC SECTION
RIGHT HAND JUNCTION BLOCK (RHJB)

PSMELC68145AB

DTC 301F

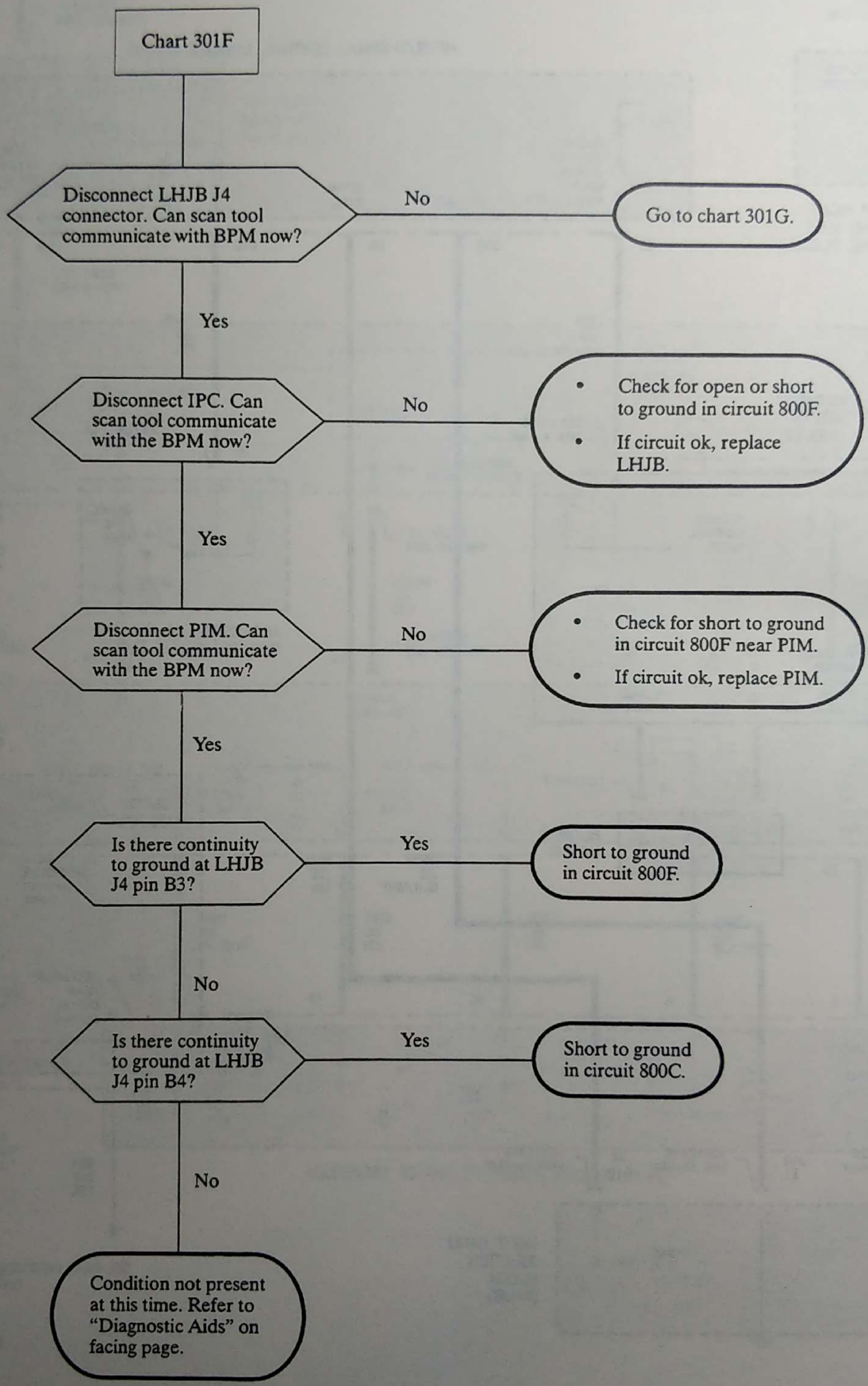


Chart 301F
Disconnect LHJB J4 connector. Can scan tool communicate with BPM now?
No
Go to chart 301G.
Yes
Disconnect IPC. Can scan tool communicate with the BPM now?
No
• Check for open or short to ground in circuit 800F.
• If circuit ok, replace LHJB.
Yes
Disconnect PIM. Can scan tool communicate with the BPM now?
No
• Check for short to ground in circuit 800F near PIM.
• If circuit ok, replace PIM.
Yes
Is there continuity to ground at LHJB J4 pin B3?
Yes
Short to ground in circuit 800F.
No
Is there continuity to ground at LHJB J4 pin B4?
Yes
Short to ground in circuit 800C.
No
Condition not present at this time. Refer to "Diagnostic Aids" on facing page.

CS CamScanner

DTC 301G

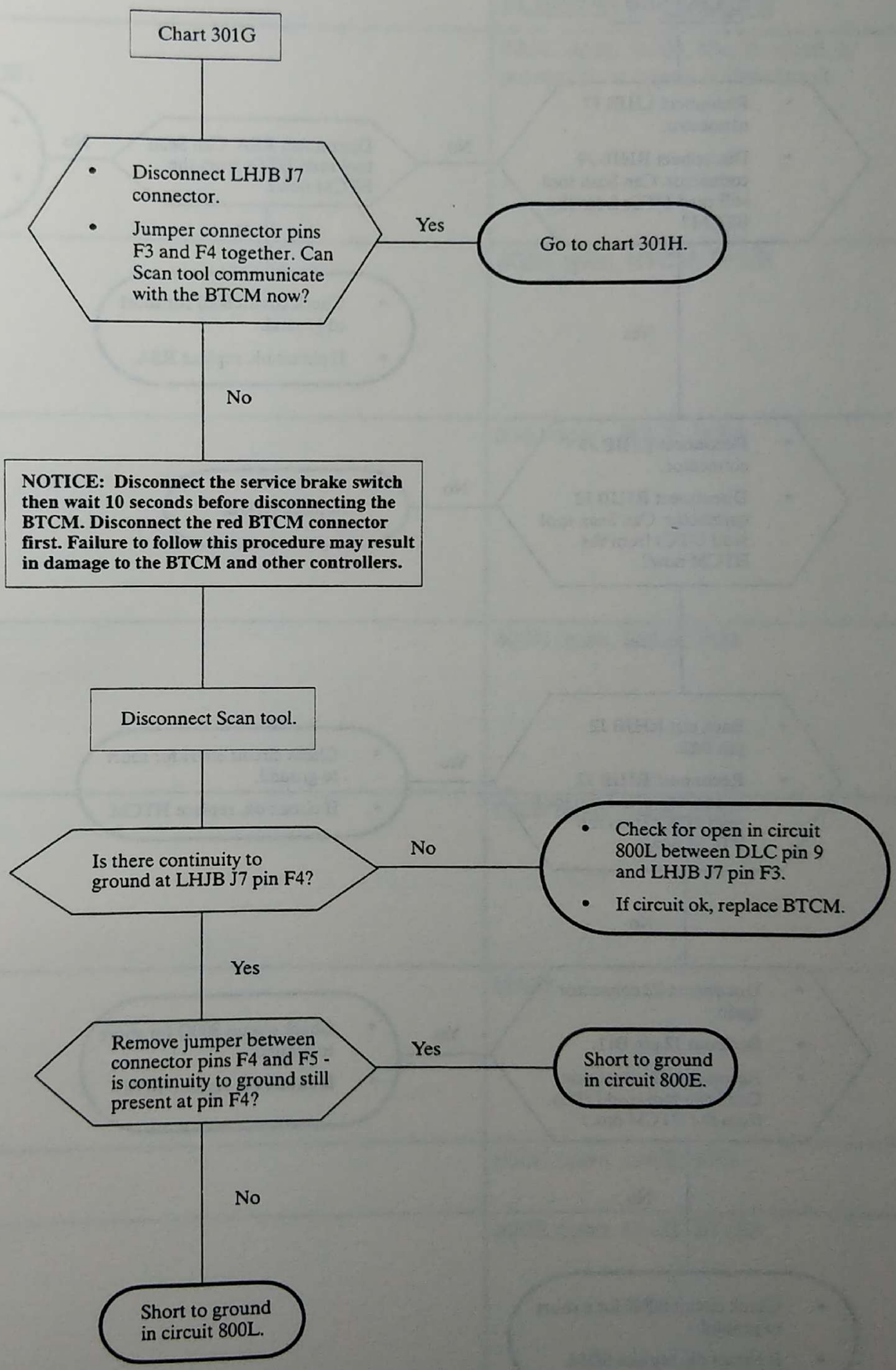


Chart 301G

- Disconnect LHJB J7 connector.
- Jumper connector pins F3 and F4 together. Can Scan tool communicate with the BTCM now?

Go to chart 301H.

NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.

Disconnect Scan tool.

Is there continuity to ground at LHJB J7 pin F4?

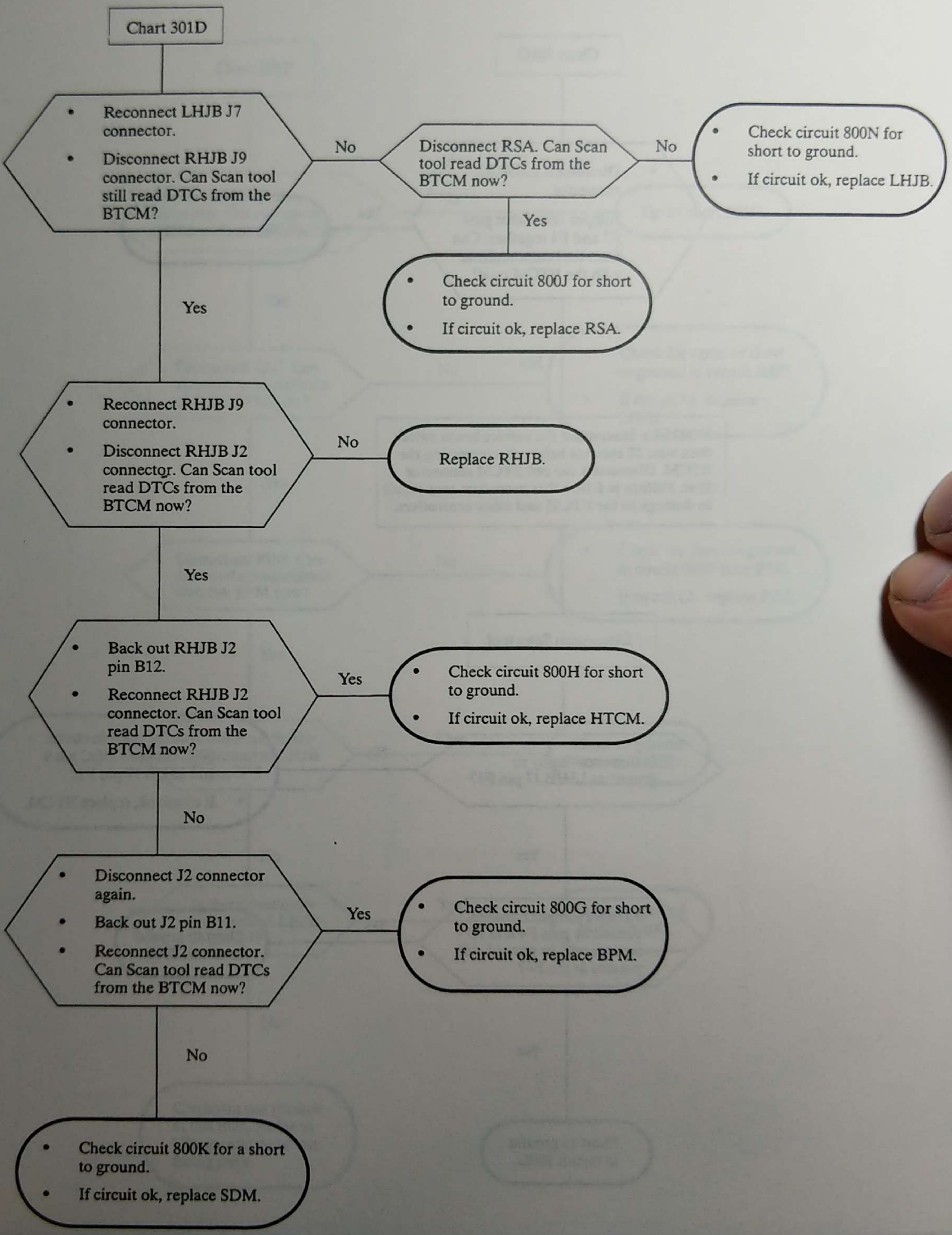
- Check for open in circuit 800L between DLC pin 9 and LHJB J7 pin F3.
- If circuit ok, replace BTCM.

Remove jumper between connector pins F4 and F5 - is continuity to ground still present at pin F4?

Short to ground in circuit 800E.

Short to ground in circuit 800L.

DTC 301H



- Reconnect LHJB J7 connector.
- Disconnect RHJB J9 connector. Can Scan tool still read DTCs from the BTCM?

Disconnect RSA. Can Scan tool read DTCs from the BTCM now?

- Check circuit 800N for short to ground.
- If circuit ok, replace LHJB.

- Check circuit 800J for short to ground.
- If circuit ok, replace RSA.

- Reconnect RHJB J9 connector.
- Disconnect RHJB J2 connector. Can Scan tool read DTCs from the BTCM now?

Replace RHJB.

- Back out RHJB J2 pin B12.
- Reconnect RHJB J2 connector. Can Scan tool read DTCs from the BTCM now?

- Check circuit 800H for short to ground.
- If circuit ok, replace HTCM.

- Disconnect J2 connector again.
- Back out J2 pin B11.
- Reconnect J2 connector. Can Scan tool read DTCs from the BTCM now?

- Check circuit 800G for short to ground.
- If circuit ok, replace BPM.

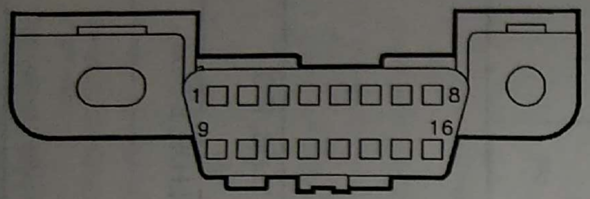
- Check circuit 800K for a short to ground.
- If circuit ok, replace SDM.

his table is meant to provide supplemental help for intermittent conditions. The table below lists serial data codes set next to the circuits and/or modules that could cause that particular combination of codes. If the codes set on this vehicle exactly match one of the sets of codes listed, the problem is most likely an intermittent open in the circuit or module(s) listed on the right. Wiggling the wires or lightly tapping on the modules in question may cause the condition to repeat.

WHICH CODES SET?	POSSIBLE CAUSES
PCM 26, 27, 28, 29 BPM 297, 298, 299, 300, 301 BTCM 72 HTCM 34, 36 IPC 11, 12, 13, 14, 15 RSA 11, 12, 13	800G open, BPM, RHJB, short to ground in any part of the circuit.
PCM 29 BPM 300 HTCM 34, 35, 36 IPC 13 RSA 12	800H open, HTCM, RHJB
PCM 26, 27, 28, 29 BPM 297, 298, 299, 301 BTCM 72 HTCM 34 IPC 11, 12, 13, 14, 15 RSA 11, 12, 13	800J open, RHJB, RSA
PCM 26, 27, 28, 29 BPM 297, 299, 301 BTCM 72 IPC 11, 12, 13, 14, 15 RSA 11, 13	800N open, LHJB, PIM
PCM 26, 27, 28, 29 BPM 301 BTCM 72 IPC 12 RSA 13	800F open, LHJB, PIM
PCM 27 BPM 297, 299 BTCM 72 IPC 11, 12, 13, 14, 15 RSA 11	LHJB
PCM 299 IPC 11, 12, 13, 14, 15	800C open, LHJB, IPC
PCM 27 BPM 297 BTCM 72 IPC 15 RSA 11	800E open, LHJB, BTCM

HARNESS CONNECTOR FACES

DATA LINK CONNECTOR (DLC)



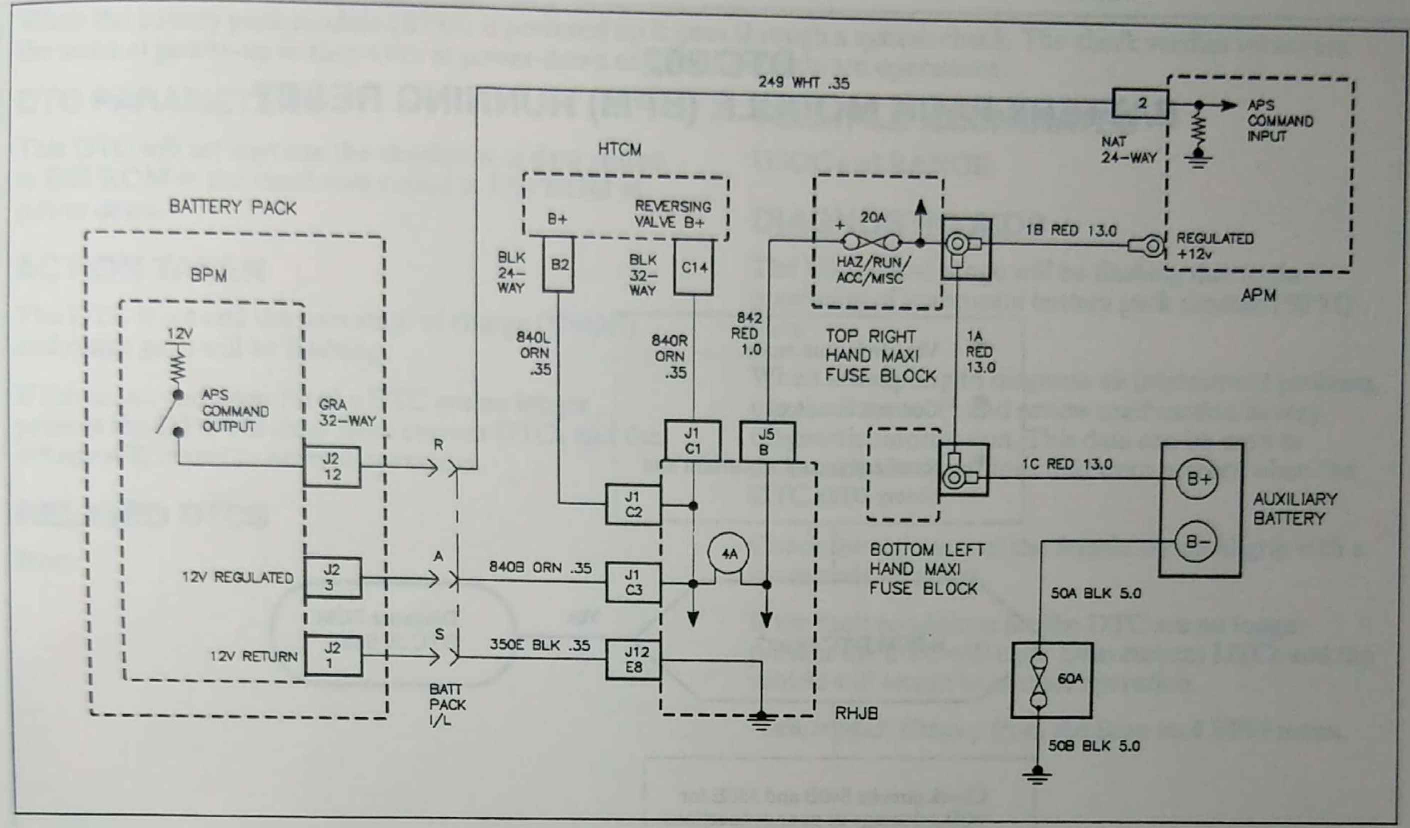
PSMELC67259AA

GRAY
12110250

DATA LINK CONNECTOR – 12110250				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
1				
2	PPL	1807C	.35	CLASS 2 DATA
3				
4	BLK	450N	.35	GROUND
5	BLK	450T	.35	GROUND
6				
7				
8				
9	TAN	800L	.35	SERIAL DATA
10				
11				
12				
13				
14				
15				
16	ORN	1640	.35	B+

Location: Passenger Compartment, Under Lower Left of I/P

DTC 302 – BATTERY PACK MODULE (BPM) RUNNING RESET


249 WHT .35
HTCM
B+
REVERSING VALVE B+
BLK 24–WAY
B2
BLK 32–WAY
C14
840L ORN .35
840R ORN .35
842 RED 1.0
BATTERY PACK
BPM
12V
APS COMMAND OUTPUT
GRA 32–WAY
J2 12
R
12V REGULATED
J2 3
A
840B ORN .35
12V RETURN
J2 1
S
350E BLK .35
BATT PACK I/L
J1 C1
J5 B
J1 C2
J1 C3
4A
J12 E8
RHJB
+
20A
HAZ/RUN/ACC/MISC
TOP RIGHT HAND MAXI FUSE BLOCK
1A RED 13.0
1B RED 13.0
2
NAT 24–WAY
APS COMMAND INPUT
REGULATED +12v
APM
BOTTOM LEFT HAND MAXI FUSE BLOCK
1C RED 13.0
B+
B–
AUXILIARY BATTERY
50A BLK 5.0
60A
50B BLK 5.0

PSMELC68203AA

BATTERY PACK MODULE (BPM) RUNNING RESET

In order for the battery pack module (BPM) to maintain its memory it receives 12 volts from the auxiliary battery when the vehicle is in the Lock mode or during charging with the accessory AC and DC power control module (APM) Off. When the BPM powers down it goes through a shut down sequence and stores away information for the next power-up cycle.

DTC PARAMETERS

This DTC will set anytime the BPM detects an improper shut down.

ACTION TAKEN

The DTC is set and the user state of charge (USOC) and range gage will be flashing.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

PCM 59

TELLTALE ILLUMINATED:

USOC and RANGE

DIAGNOSTIC AIDS

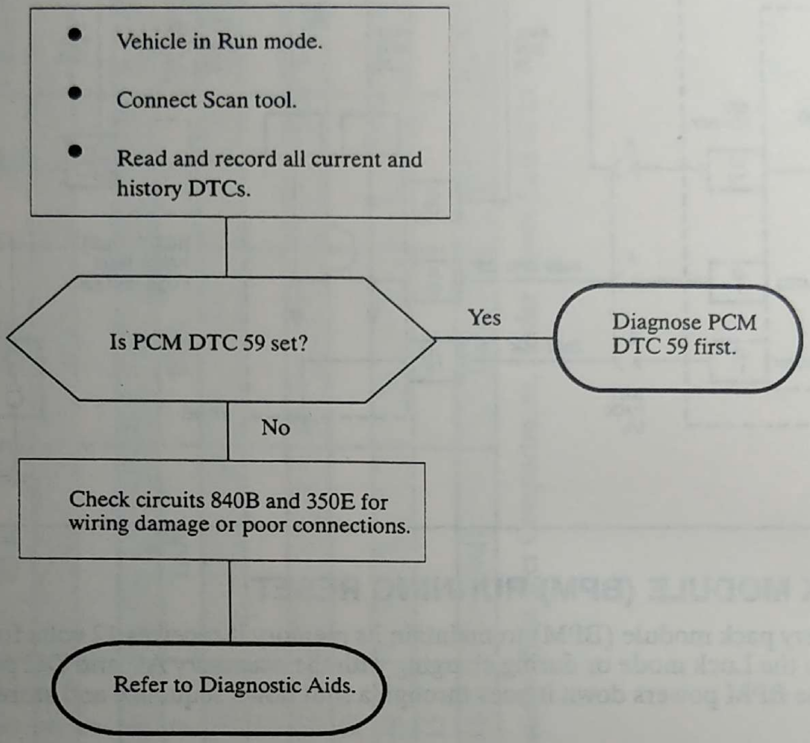
The USOC and range will be flashing due to the possibility of inaccurate BPM data.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

Check the tightness of the female terminal grip with a spare male terminal.

*Select Malf History from the Scan tool BPM menu.

DTC 302
BATTERY PACK MODULE (BPM) RUNNING RESET



- Vehicle in Run mode.
- Connect Scan tool.
- Read and record all current and history DTCs.

Is PCM DTC 59 set?

Yes: Diagnose PCM DTC 59 first.

No: Check circuits 840B and 350E for wiring damage or poor connections.

Refer to Diagnostic Aids.

DTC 303 – EEPROM CHECKSUM FAULT

When the battery pack module (BPM) is powered up it goes through a system check. The check verifies values are the same at power-up as they were at power-down and verifies hardware operations.

DTC PARAMETERS

This DTC will set anytime the checksum of data stored in EEPROM = the checksum stored in EEPROM at power down.

ACTION TAKEN

The DTC is set and the user state of charge (USOC) and range gage will be flashing.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

USOC and RANGE

DIAGNOSTIC AIDS

The USOC and range will be flashing due to the possibility of inaccurate battery pack module (BPM) data.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

Check the tightness of the female terminal grip with a spare male terminal.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

*Select Malf History from the Scan tool BPM menu.

DTC 303
EEPROM CHECKSUM FAULT

- If this DTC is set it is due to an internal BPM problem.
- Connect Scan tool. Read and record all current and history DTCs.
- Replace BPM.
- Print out all malfunction history data. Attach malfunction data to a copy of the repair order and return with BPM.

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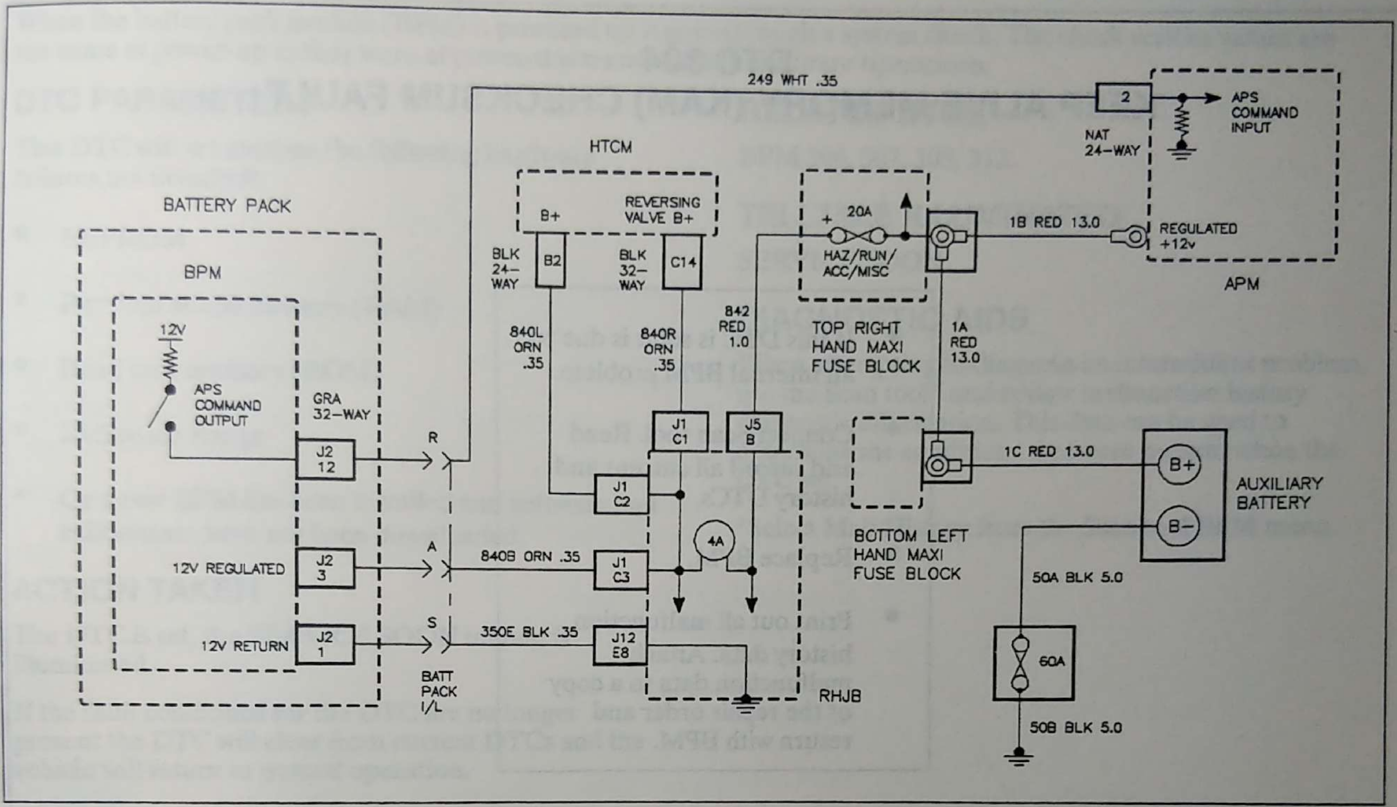
DTC 304 – KEEP ALIVE MEMORY (KAM) CHECKSUM FAULT


249 WHT .35
HTCM
B+
REVERSING VALVE B+
BLK 24–WAY
B2
BLK 32–WAY
C14
BATTERY PACK
BPM
12V
APS COMMAND OUTPUT
GRA 32–WAY
J2 12
R
J2 3
A
12V REGULATED
J2 1
S
12V RETURN
BATT PACK I/L
840L ORN .35
840R ORN .35
842 RED 1.0
J1 C1
J5 B
J1 C2
4A
840B ORN .35
J1 C3
350E BLK .35
J12 E8
RHJB
20A
+
HAZ/RUN/ACC/MISC
TOP RIGHT HAND MAXI FUSE BLOCK
1A RED 13.0
1B RED 13.0
BOTTOM LEFT HAND MAXI FUSE BLOCK
1C RED 13.0
2
NAT 24–WAY
APS COMMAND INPUT
REGULATED +12v
APM
B+
B–
AUXILIARY BATTERY
50A BLK 5.0
60A
50B BLK 5.0

PSMELC68203AA

KEEP ALIVE MEMORY (KAM) CHECKSUM FAULT

When the battery pack module (BPM) is powered up it goes through a system check. The check verifies values are the same at power-up as they were at power-down and verifies hardware operations.

DTC PARAMETERS

This DTC will set anytime the data stored in KAM does not equal data stored in KAM at power down.

ACTION TAKEN

The DTC is set.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BPM menu.

DTC 304
KEEP ALIVE MEMORY (KAM) CHECKSUM FAULT

- If this DTC is set it is due to an internal BPM problem.
- Connect Scan tool. Read and record all current and history DTCs.
- Replace BPM.
- Print out all malfunction history data. Attach malfunction data to a copy of the repair order and return with BPM.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

CS CamScanner

DTC 305 – BATTERY PACK MODULE (BPM) HARDWARE MALFUNCTION

When the battery pack module (BPM) is powered up it goes through a system check. The check verifies values are the same at power-up as they were at power-down and verifies hardware operations.

DTC PARAMETERS

This DTC will set anytime the following hardware failures are detected:

- EEPROM
- Random access memory (RAM)
- Read only memory (ROM)
- Reference Range
- Or a new BPM has been installed and software and calibrations have not been downloaded.

ACTION TAKEN

The DTC is set, the SERVICE SOON telltale is illuminated.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 306, 307, 308, 312.

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BPM menu.

DTC 305
BATTERY PACK MODULE (BPM) HARDWARE MALFUNCTION

IMPORTANT: If a new BPM has been installed this DTC will set if software/calibrations have not been downloaded. Reprogram BPM using the Saturn service stall system.

- If this DTC is set it is due to an internal BPM problem.
- Connect Scan tool. Read and record all current and history DTCs.
- Replace BPM.
- Print out all malfunction history data. Attach malfunction data to a copy of the repair order and return with BPM.

DTC 306 – EEPROM MALFUNCTION

When the battery pack module (BPM) is powered up it goes through a system check. The check verifies values are the same at power-up as they were at power-down and verifies hardware operations.

DTC PARAMETERS

This DTC will set anytime the BPM detects an EEPROM malfunction.

OR

A new BPM has been installed and software/calibrations have not been downloaded.

ACTION TAKEN

The DTC is set, the SERVICE SOON telltale is illuminated and the charging is disabled.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BPM menu.

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DTC 306
EEPROM MALFUNCTION

IMPORTANT: If a new BPM has been installed this DTC will set if software/calibrations have not been downloaded. Reprogram BPM using the Saturn service stall system.

- If this DTC is set it is due to an internal BPM problem.
- Connect Scan tool. Read and record all current and history DTCs.
- Replace BPM.
- Print out all malfunction history data. Attach malfunction data to a copy of the repair order and return with BPM.

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DTC 307 – RANDOM ACCESS MEMORY (RAM) MALFUNCTION

When the battery pack module (BPM) is powered up it goes through a system check. The check verifies values are the same at power-up as they were at power-down and verifies hardware operations.

DTC PARAMETERS

This DTC will set anytime the BPM detects RAM malfunction.

OR

A new BPM has been installed and software/calibrations have not been downloaded.

ACTION TAKEN

The DTC is set, the SERVICE SOON telltale is illuminated and charging is disabled.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BPM menu.

DTC 307
RANDOM ACCESS MEMORY (RAM) MALFUNCTION

IMPORTANT: If a new BPM has been installed this DTC will set if software/calibrations have not been downloaded. Reprogram BPM using the Saturn service stall system.

- If this DTC is set it is due to an internal BPM problem.
- Connect Scan tool. Read and record all current and history DTCs.
- Replace BPM.
- Print out all malfunction history data. Attach malfunction data to a copy of the repair order and return with BPM.

CS CamScanner

DTC 308 – READ ONLY MEMORY (ROM) MALFUNCTION

When the battery pack module (BPM) is powered up it goes through a system check. The check verifies values are the same at power-up as they were at power-down and verifies hardware operations.

DTC PARAMETERS

This DTC will set anytime the BPM detects a read-only memory (ROM) malfunction.

OR

A new BPM has been installed and software/calibrations have not been downloaded.

ACTION TAKEN

The DTC is set, the SERVICE SOON telltale is illuminated and charging is disabled.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BPM menu.

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DTC 308

READ ONLY MEMORY (ROM) MALFUNCTION

IMPORTANT: If a new BPM has been installed this DTC will set if software/calibrations have not been downloaded. Reprogram BPM using the Saturn service stall system.

- If this DTC is set it is due to an internal BPM problem.
- Connect Scan tool. Read and record all current and history DTCs.
- Replace BPM.
- Print out all malfunction history data. Attach malfunction data to a copy of the repair order and return with BPM.

DTC 309 – REFERENCE RANGE FAULT

The battery pack module (BPM) contains a high precision power supply used to read the battery module voltages. The power supply has two voltage levels – zero volts and ten volts.

DTC PARAMETERS

This DTC will set anytime one or both of the reference range voltages are out of range. Voltages are zero volts and ten volts.

ACTION TAKEN

The DTC is set, the SERVICE SOON telltale is illuminated, charging will be disabled and battery module voltage readings will be invalid.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

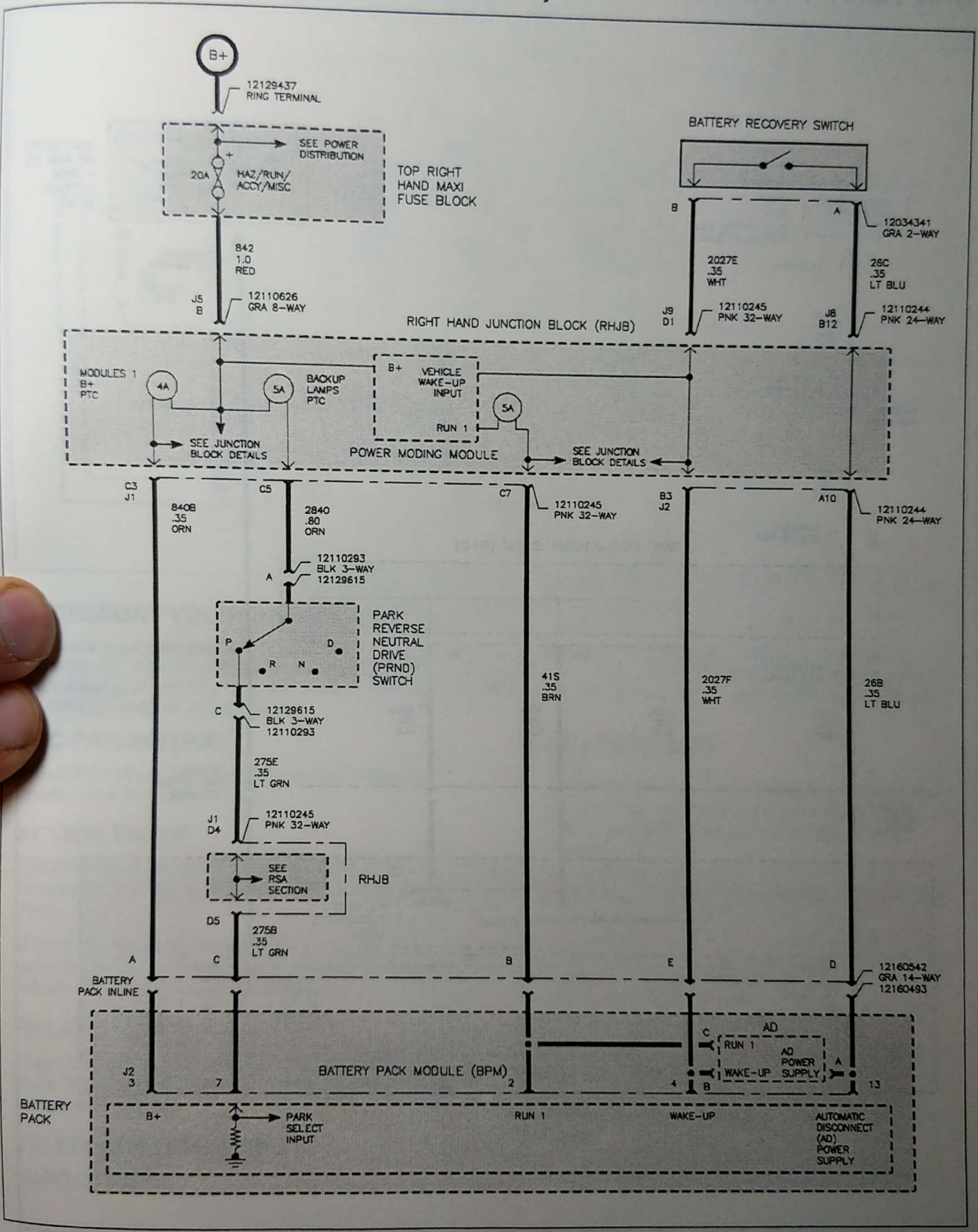
*Select Malf History from the Scan tool BPM menu.

DTC 309
REFERENCE RANGE FAULT

IMPORTANT: If a new BPM has been installed this DTC will set if software/calibrations have not been downloaded. Reprogram BPM using the Saturn service stall system.

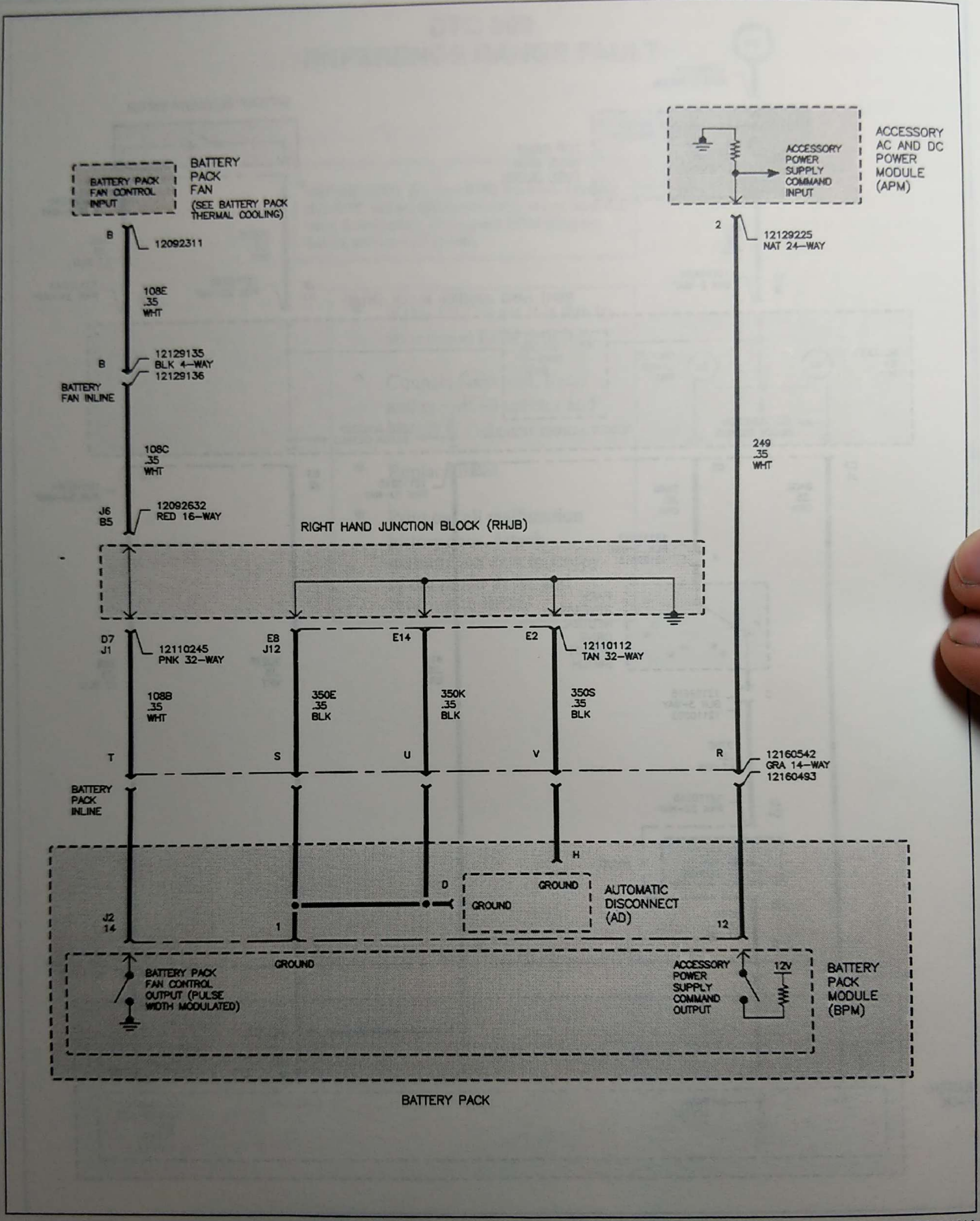
- If this DTC is set it is due to an internal BPM problem.
- Connect Scan tool. Read and record all current and history DTCs.
- Replace BPM.
- Print out all malfunction history data. Attach malfunction data to a copy of the repair order and return with BPM.

BATTERY PACK (LOW VOLTAGE)


B+
12129437
RING TERMINAL
SEE POWER DISTRIBUTION
20A
HAZ/RUN/ACCY/MISC
TOP RIGHT HAND MAXI FUSE BLOCK
842
1.0
RED
J5
B
12110626
GRA 8–WAY
RIGHT HAND JUNCTION BLOCK (RHJB)
BATTERY RECOVERY SWITCH
B
A
12034341
GRA 2–WAY
2027E
.35
WHT
26C
.35
LT BLU
J9
D1
12110245
PNK 32–WAY
J8
B12
12110244
PNK 24–WAY
MODULES 1
B+
PTC
4A
5A
BACKUP LAMPS PTC
B+
VEHICLE WAKE–UP INPUT
RUN 1
5A
SEE JUNCTION BLOCK DETAILS
POWER MODING MODULE
SEE JUNCTION BLOCK DETAILS
C3
J1
840B
.35
ORN
C5
2840
.80
ORN
C7
12110245
PNK 32–WAY
B3
J2
A10
12110244
PNK 24–WAY
12110293
BLK 3–WAY
12129615
A
P
D
R
N
PARK REVERSE NEUTRAL DRIVE (PRND) SWITCH
C
12129615
BLK 3–WAY
12110293
41S
.35
BRN
2027F
.35
WHT
26B
.35
LT BLU
275E
.35
LT GRN
J1
D4
12110245
PNK 32–WAY
SEE RSA SECTION
RHJB
D5
275B
.35
LT GRN
A
C
B
E
D
BATTERY PACK INLINE
12160542
GRA 14–WAY
12160493
AD
C
RUN 1
AD POWER SUPPLY
WAKE–UP
A
B
BATTERY PACK MODULE (BPM)
J2
3
7
2
4
13
BATTERY PACK
B+
PARK SELECT INPUT
RUN 1
WAKE–UP
AUTOMATIC DISCONNECT (AD) POWER SUPPLY

PSMELC68117AA

BATTERY PACK (LOW VOLTAGE)


BATTERY PACK FAN CONTROL INPUT
BATTERY PACK FAN
(SEE BATTERY PACK THERMAL COOLING)
B
12092311
108E
.35
WHT
B
12129135
BLK 4–WAY
12129136
BATTERY FAN INLINE
108C
.35
WHT
J6
B5
12092632
RED 16–WAY
RIGHT HAND JUNCTION BLOCK (RHJB)
D7
J1
12110245
PNK 32–WAY
E8
J12
E14
E2
12110112
TAN 32–WAY
108B
.35
WHT
350E
.35
BLK
350K
.35
BLK
350S
.35
BLK
T
S
U
V
R
12160542
GRA 14–WAY
12160493
BATTERY PACK INLINE
H
D
GROUND
GROUND
AUTOMATIC DISCONNECT (AD)
J2
14
1
12
GROUND
BATTERY PACK FAN CONTROL OUTPUT (PULSE WIDTH MODULATED)
ACCESSORY POWER SUPPLY COMMAND OUTPUT
12V
BATTERY PACK MODULE (BPM)
BATTERY PACK
ACCESSORY POWER SUPPLY COMMAND INPUT
ACCESSORY AC AND DC POWER MODULE (APM)
2
12129225
NAT 24–WAY
249
.35
WHT

PSMELC68119AA

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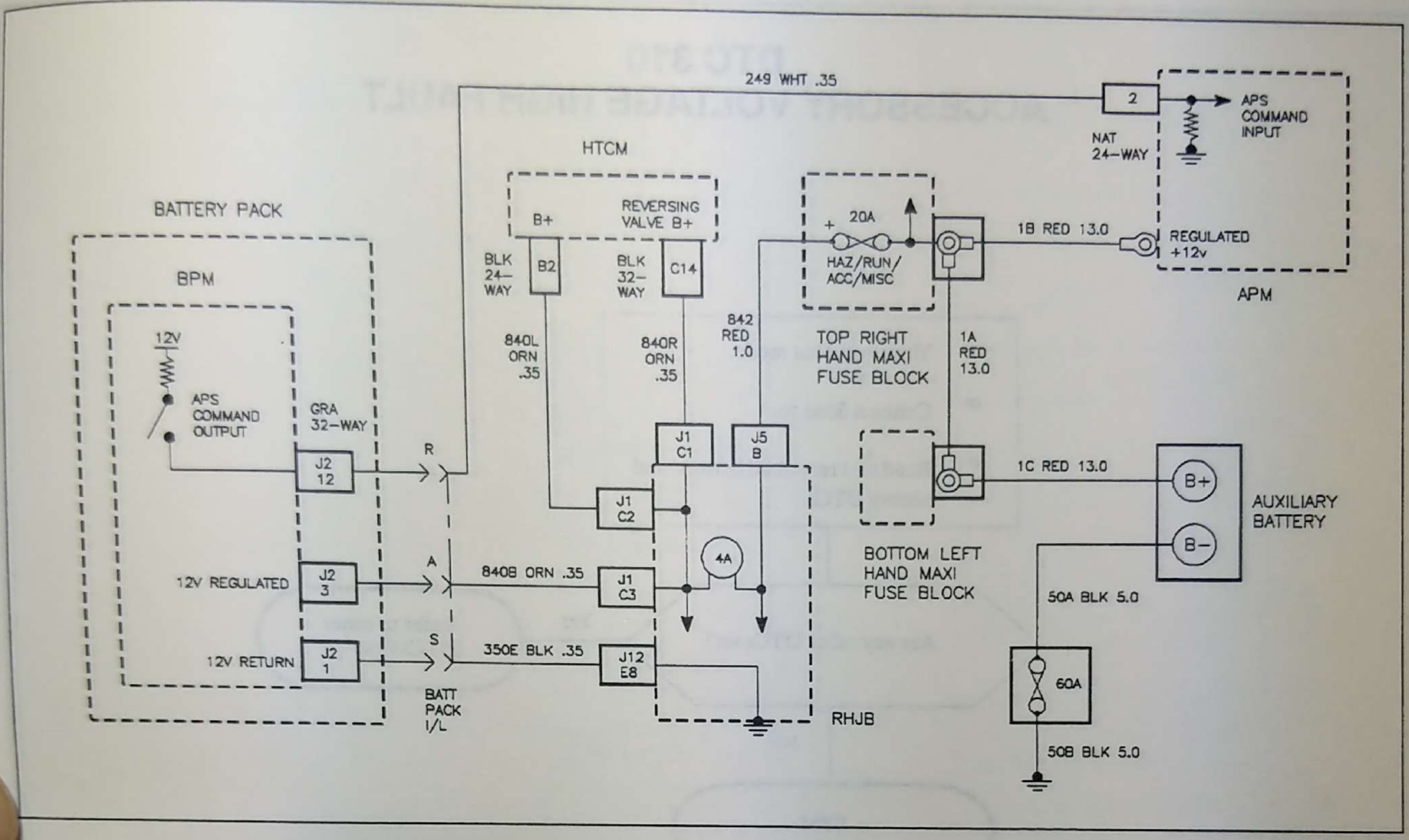
DTC 310 – ACCESSORY VOLTAGE HIGH FAULT


249 WHT .35
2
NAT 24–WAY
APS COMMAND INPUT
HTCM
B+
REVERSING VALVE B+
BATTERY PACK
BLK 24–WAY
B2
BLK 32–WAY
C14
+
20A
HAZ/RUN/ ACC/MISC
1B RED 13.0
REGULATED +12v
APM
BPM
12V
APS COMMAND OUTPUT
GRA 32–WAY
840L ORN .35
840R ORN .35
842 RED 1.0
TOP RIGHT HAND MAXI FUSE BLOCK
1A RED 13.0
J1 C1
J5 B
J2 12
R
J1 C2
1C RED 13.0
B+
AUXILIARY BATTERY
B–
A
4A
12V REGULATED
J2 3
840B ORN .35
J1 C3
BOTTOM LEFT HAND MAXI FUSE BLOCK
50A BLK 5.0
S
12V RETURN
J2 1
350E BLK .35
J12 E8
60A
BATT PACK I/L
RHJB
50B BLK 5.0
PSMELC68203AA

ACCESSORY VOLTAGE HIGH FAULT

The battery pack module (BPM) contains two circuit boards, a high voltage board and a low voltage board. The accessory AC and DC power control module (APM) and/or auxiliary battery 12V to the BPM. (When APM is Off the voltage is fed directly from the auxiliary battery.) The BPM creates an internal 12 volt signal, accessory voltage, for the high and low voltage boards.

DTC PARAMETERS

This DTC will set anytime the accessory voltage is greater than 16.0 volts.

ACTION TAKEN

The DTC is set, the SERVICE SOON telltale is illuminated and the BPM high voltage board is shut down.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

Propulsion control module (PCM) accessory voltage fault. (If not present, fault is between APM and BPM or internal to BPM).

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

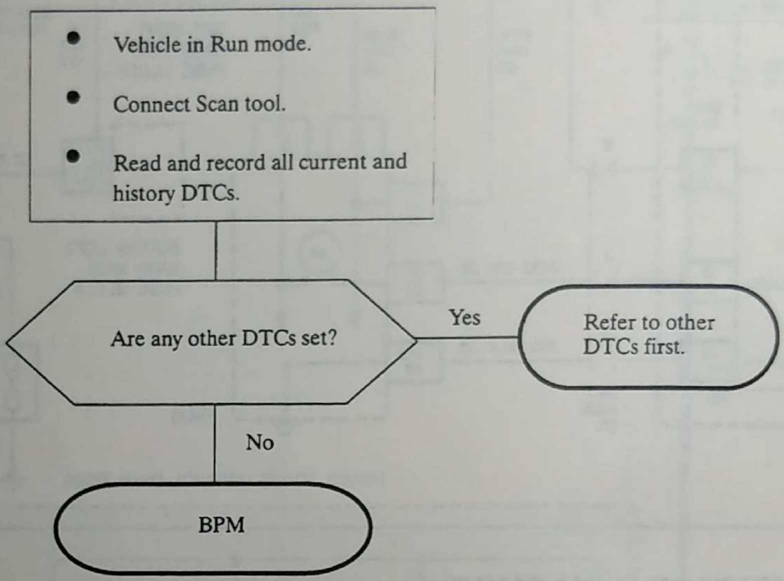
- When this failure occurs the module voltages and pack voltages will reflect the last valid reading before the BPM shuts down the high voltage board.
- If attempt is made to charge vehicle this DTC may be set falsely.

NOTICE: Do not attempt to recharge the auxiliary battery in the vehicle. Attempting to charge auxiliary battery in the vehicle may cause damage to vehicle components.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

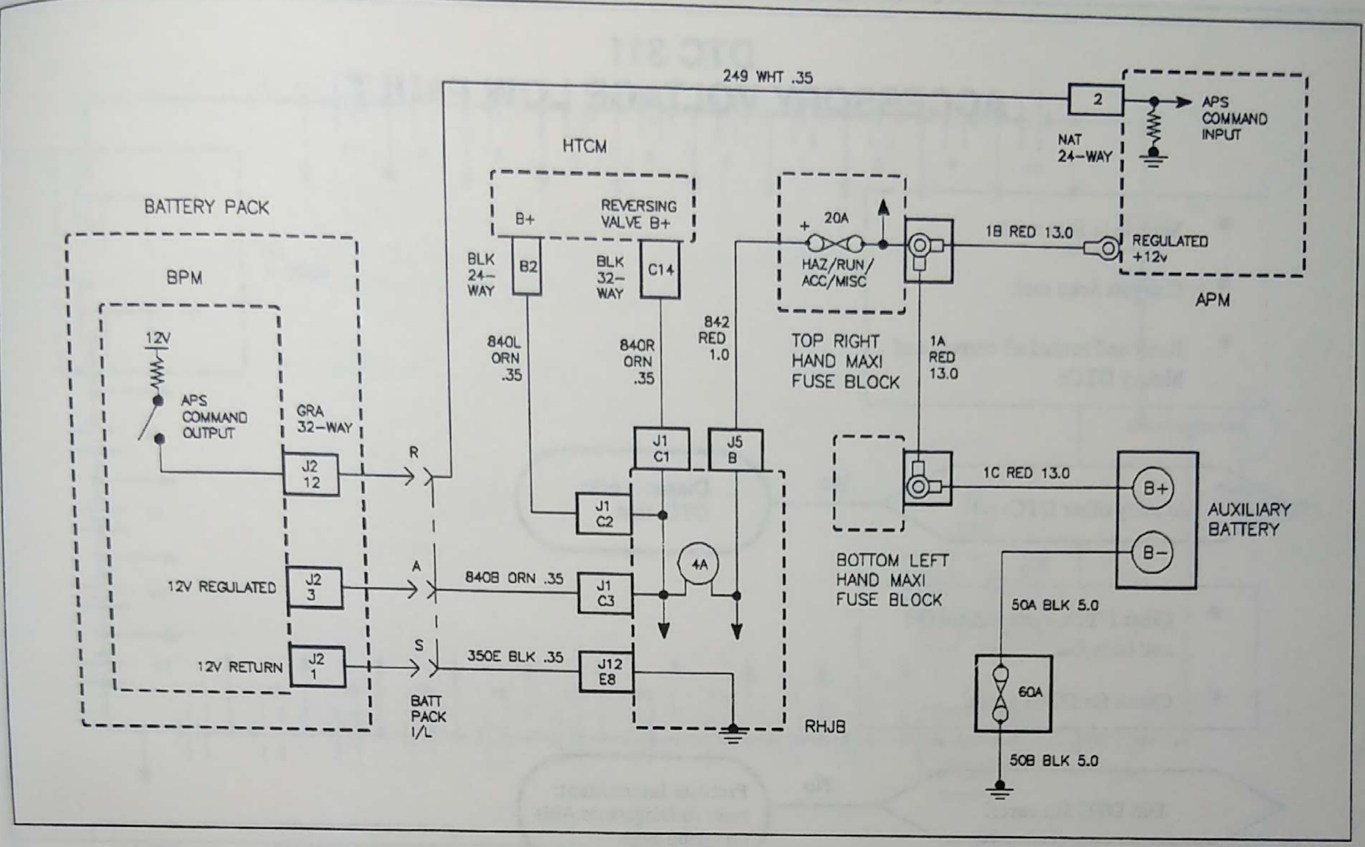
*Select Malf History from the Scan tool BPM menu.

DTC 310
ACCESSORY VOLTAGE HIGH FAULT


Vehicle in Run mode.
Connect Scan tool.
Read and record all current and history DTCs.
Are any other DTCs set?
Yes
Refer to other DTCs first.
No
BPM

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 311 – ACCESSORY VOLTAGE LOW FAULT


249 WHT .35
2
NAT
24–WAY
APS
COMMAND
INPUT
HTCM
B+
REVERSING
VALVE B+
BATTERY PACK
BPM
BLK
24–
WAY
B2
BLK
32–
WAY
C14
+
20A
HAZ/RUN/
ACC/MISC
1B RED 13.0
REGULATED
+12v
APM
12V
APS
COMMAND
OUTPUT
GRA
32–WAY
840L
ORN
.35
840R
ORN
.35
842
RED
1.0
TOP RIGHT
HAND MAXI
FUSE BLOCK
1A
RED
13.0
J1
C1
J5
B
R
J2
12
J1
C2
1C RED 13.0
B+
B–
AUXILIARY
BATTERY
4A
A
12V REGULATED
J2
3
840B ORN .35
J1
C3
BOTTOM LEFT
HAND MAXI
FUSE BLOCK
50A BLK 5.0
S
12V RETURN
J2
1
350E BLK .35
J12
E8
60A
BATT
PACK
I/L
RHJB
50B BLK 5.0

PSMELC68203AA

ACCESSORY VOLTAGE LOW FAULT

The battery pack module (BPM) contains two circuit boards, a high voltage board and a low voltage board. The accessory AC and DC power control module (APM) and/or auxiliary battery supplies 12V to the BPM. (When APM is Off the voltage is fed directly from the auxiliary battery). The BPM creates an internal 12 volt signal, accessory voltage, for the high and low voltage boards.

DTC PARAMETERS

This DTC will set anytime the accessory voltage is lower than 8.75 volts.

ACTION TAKEN

The DTC is set, the SERVICE SOON telltale is illuminated and the BPM high voltage board is shut down.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

None

TELLTALE ILLUMINATED

SERVICE SOON

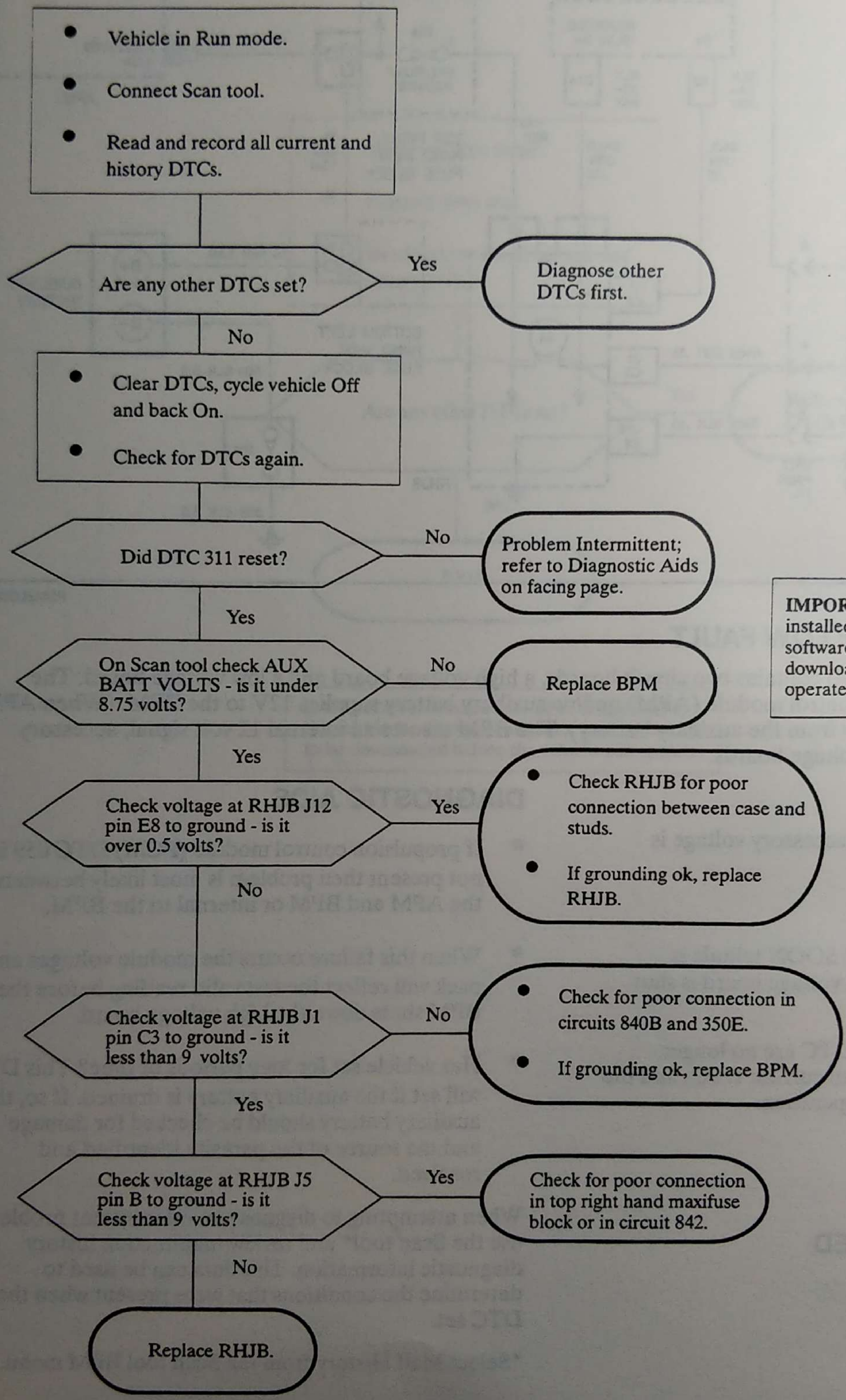
DIAGNOSTIC AIDS

- If propulsion control module (PCM) DTC 059 is not present then problem is most likely between the APM and BPM or internal to the BPM.
- When this failure occurs the module voltages and pack will reflect the last valid reading before the BPM shuts down the high voltage board.
- Has vehicle sat for long periods of time? This DTC will set if the auxiliary battery is drained. If so, the auxiliary battery should be checked for damage and the source of the parasite identified and resolved.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

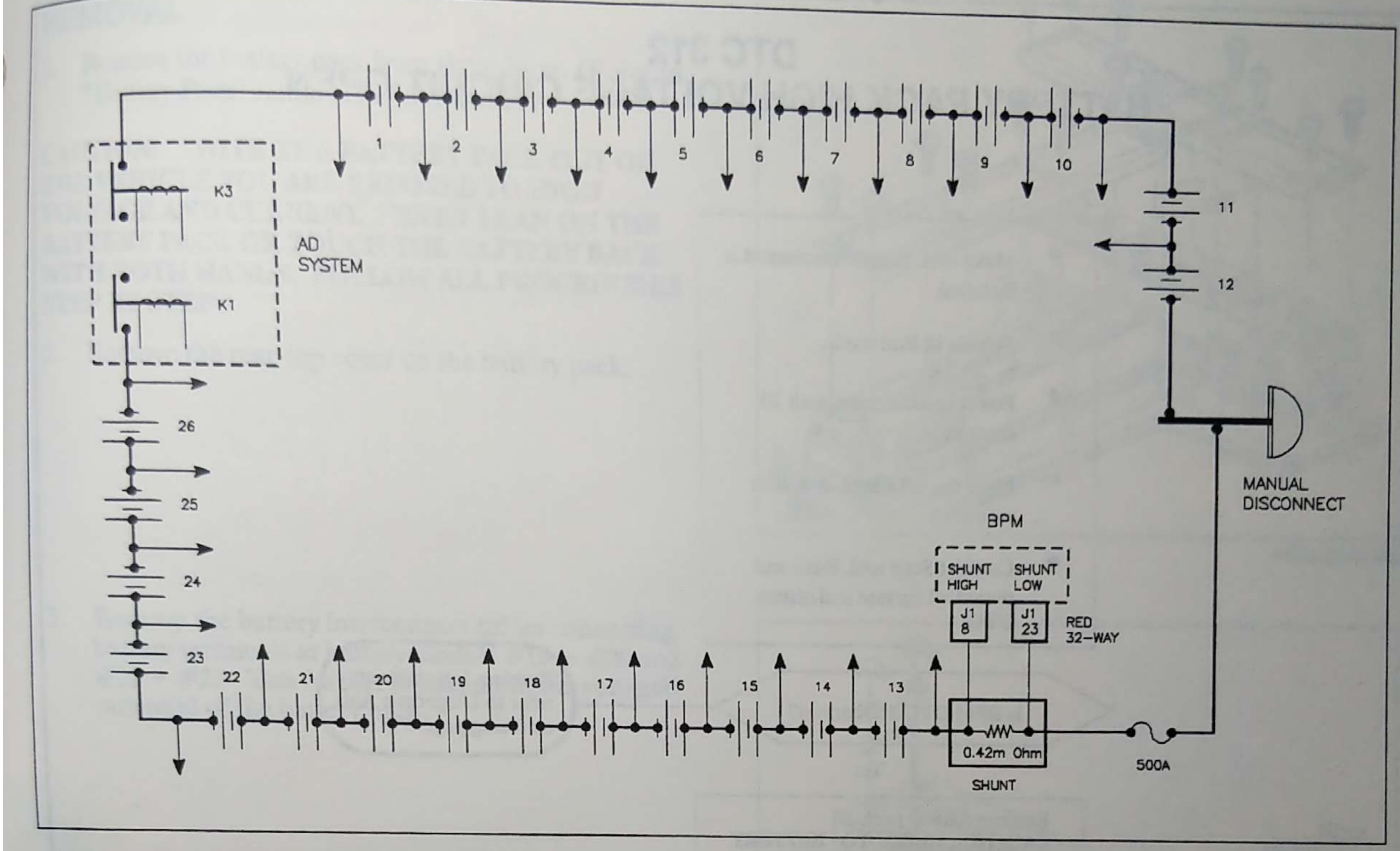
*Select Malf History from the Scan tool BPM menu.

DTC 311
ACCESSORY VOLTAGE LOW FAULT


Vehicle in Run mode.
Connect Scan tool.
Read and record all current and history DTCs.
Are any other DTCs set?
Yes
Diagnose other DTCs first.
No
Clear DTCs, cycle vehicle Off and back On.
Check for DTCs again.
Did DTC 311 reset?
No
Problem Intermittent; refer to Diagnostic Aids on facing page.
Yes
On Scan tool check AUX BATT VOLTS - is it under 8.75 volts?
No
Replace BPM
Yes
Check voltage at RHJB J12 pin E8 to ground - is it over 0.5 volts?
Yes
Check RHJB for poor connection between case and studs.
If grounding ok, replace RHJB.
No
Check voltage at RHJB J1 pin C3 to ground - is it less than 9 volts?
No
Check for poor connection in circuits 840B and 350E.
If grounding ok, replace BPM.
Yes
Check voltage at RHJB J5 pin B to ground - is it less than 9 volts?
Yes
Check for poor connection in top right hand maxifuse block or in circuit 842.
No
Replace RHJB.

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

DTC 312 – BATTERY PACK HIGH VOLTAGE CIRCUIT OPEN


1
2
3
4
5
6
7
8
9
10
11
12
K3
AD
SYSTEM
K1
26
25
24
23
22
21
20
19
18
17
16
15
14
13
MANUAL
DISCONNECT
BPM
SHUNT
HIGH
SHUNT
LOW
J1
8
J1
23
RED
32–WAY
0.42m Ohm
SHUNT
500A

PSMELC68208AA

BATTERY PACK HIGH VOLTAGE CIRCUIT OPEN

DTC PARAMETERS

This DTC will set anytime the battery pack module (BPM) PACK high voltage is less than PACK low voltage.

When PACK HI < PACK LO = HV open.

ACTION TAKEN

The DTC is set, the SERVICE SOON telltale is illuminated and charging will be disabled.

If the fault conditions for the DTC are no longer present the DTC will clear from current DTCs and the vehicle will return to normal operation.

RELATED DTCS

BPM 280

TELLTALE ILLUMINATED

SERVICE SOON

DIAGNOSTIC AIDS

Pulling manual disconnect knob out will set 312, 280 and/or 275.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

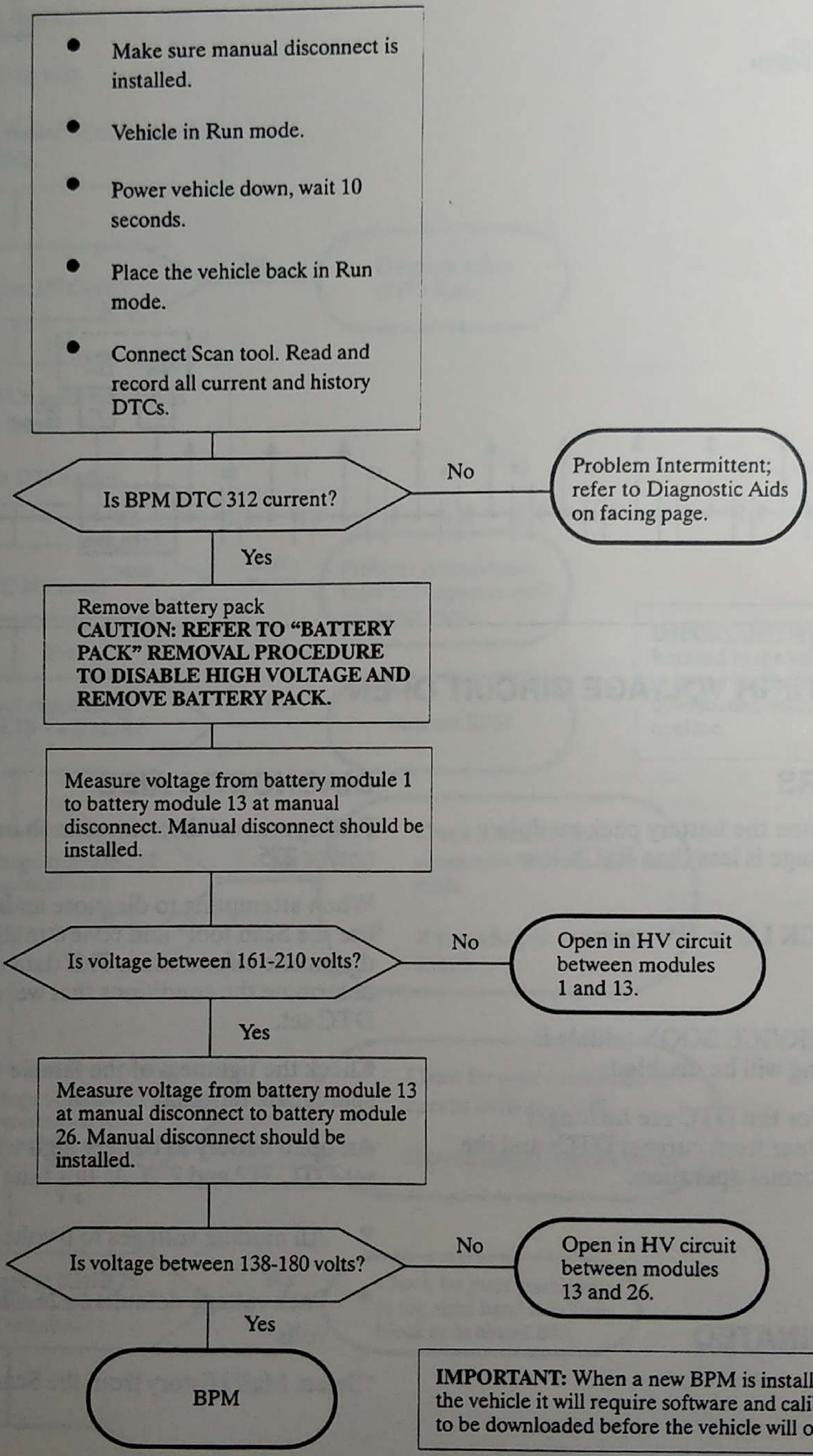
Check the tightness of the female terminal grip with a spare male terminal.

An open battery to battery high voltage (HV) cable will set DTC 312 and 280. At this time BPM will set:

- All module voltages to 0 volts (HV board goes off).
- Pack voltage defaults to 26 x 13.0 volts = 338.0 volts

*Select Malf History from the Scan tool BPM menu.

DTC 312
BATTERY PACK HIGH VOLTAGE CIRCUIT OPEN


Make sure manual disconnect is installed.
Vehicle in Run mode.
Power vehicle down, wait 10 seconds.
Place the vehicle back in Run mode.
Connect Scan tool. Read and record all current and history DTCs.
Is BPM DTC 312 current?
No
Problem Intermittent; refer to Diagnostic Aids on facing page.
Yes
Remove battery pack
CAUTION: REFER TO "BATTERY PACK" REMOVAL PROCEDURE TO DISABLE HIGH VOLTAGE AND REMOVE BATTERY PACK.
Measure voltage from battery module 1 to battery module 13 at manual disconnect. Manual disconnect should be installed.
Is voltage between 161-210 volts?
No
Open in HV circuit between modules 1 and 13.
Yes
Measure voltage from battery module 13 at manual disconnect to battery module 26. Manual disconnect should be installed.
Is voltage between 138-180 volts?
No
Open in HV circuit between modules 13 and 26.
Yes
BPM

IMPORTANT: When a new BPM is installed in the vehicle it will require software and calibrations to be downloaded before the vehicle will operate.

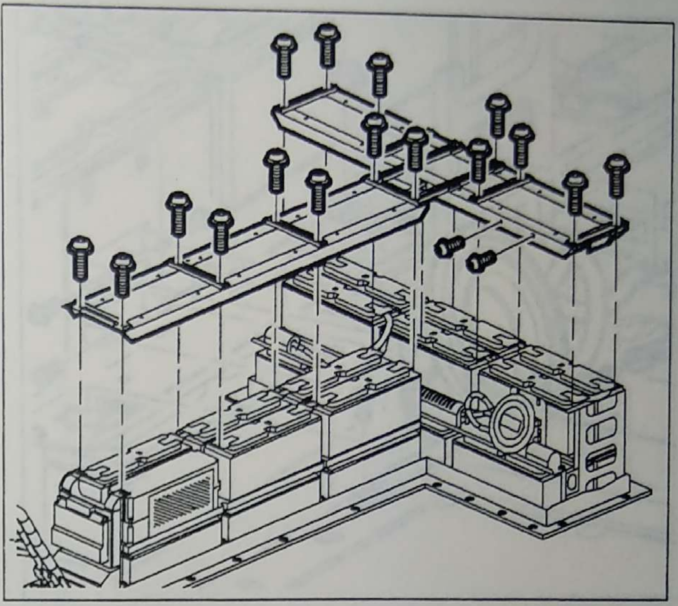
MANUAL DISCONNECT

REMOVAL

1. Remove the battery pack from the vehicle. (Refer to "Battery Pack" removal in this manual.)

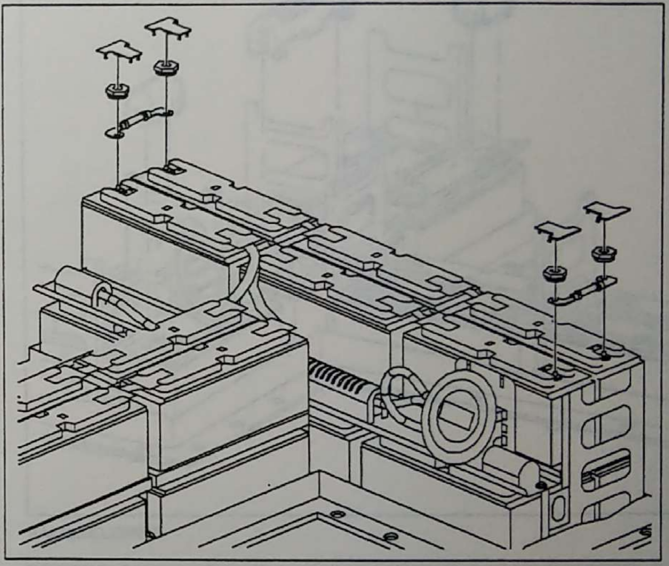
CAUTION: WITH THE BATTERY PACK OUT OF THE VEHICLE YOU ARE EXPOSED TO HIGH VOLTAGE AND CURRENT. NEVER LEAN ON THE BATTERY PACK OR TOUCH THE BATTERY BACK WITH BOTH HANDS. FOLLOW ALL PROCEDURES STEP BY STEP.

2. Remove the rear-top cover on the battery pack.



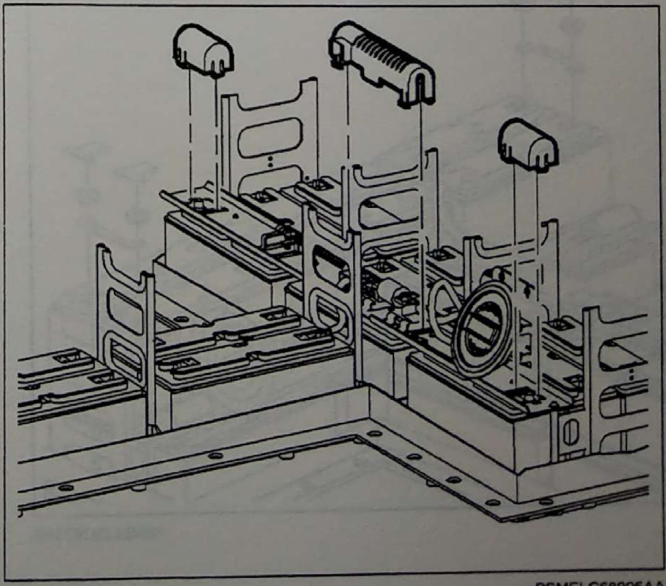
PSMELC67066AB

3. Remove the battery interconnect cables connecting battery terminals at battery module #19 – #20 and #22 – #23. This further breaks down the voltage potential of the battery pack.

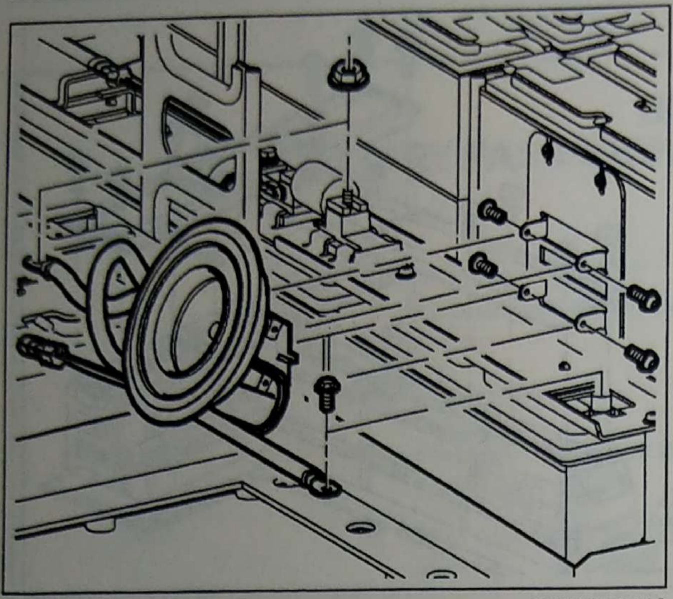


PSMELC67073AB

4. Remove the covers on the stud extension from module 12 and the fuse/shunt cover.
5. Remove the bolt from extension stud holding the manual disconnect cable.
6. Remove the bolt from the shunt holding the other manual disconnect cable.



PSMELC68025AA



PSMELC67071AC

7. Remove the four screws holding the manual disconnect assembly.

INSTALLATION

1. Install manual disconnect and four screws.

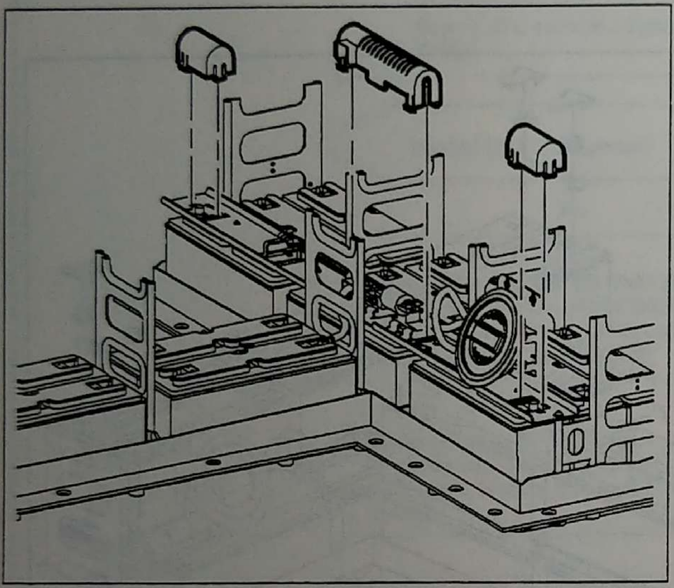
Torque: 1 N•m (9 in-lbs)

2. Install manual disconnect cable to the extension stud.

Torque: 10 N•m (89 in-lbs)

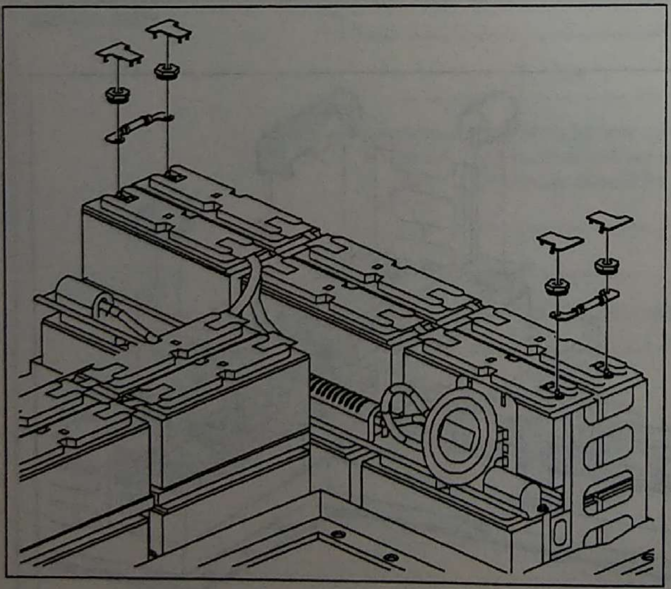
3. Install manual disconnect cable to the stunt.

Torque: 10 N•m (89 in-lbs)



PSMELC68025AA

4. Install the covers on the stud extension from module 12 and the fuse/shunt cover.



PSMELC67073AB

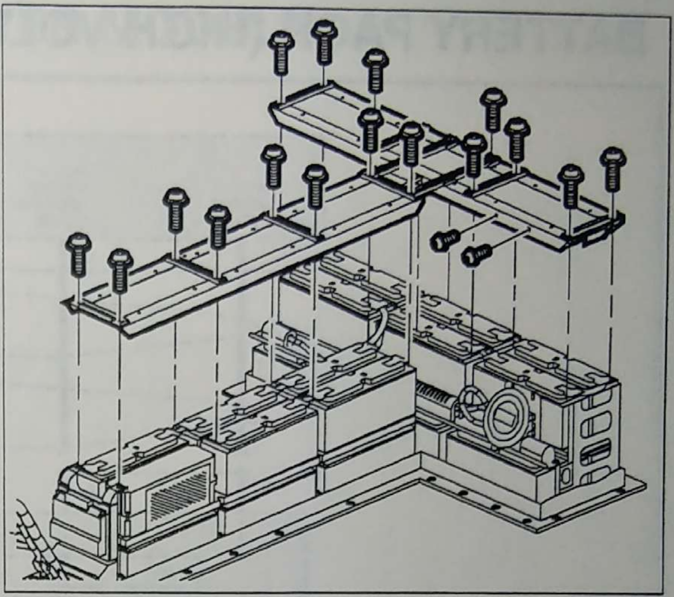
5. Install the battery interconnect cables connecting battery terminals at battery modules #19 – #20 and #22 – #23.

Torque: 10 N•m (89 in-lbs)

6. Install the rear-top cover on the battery pack.

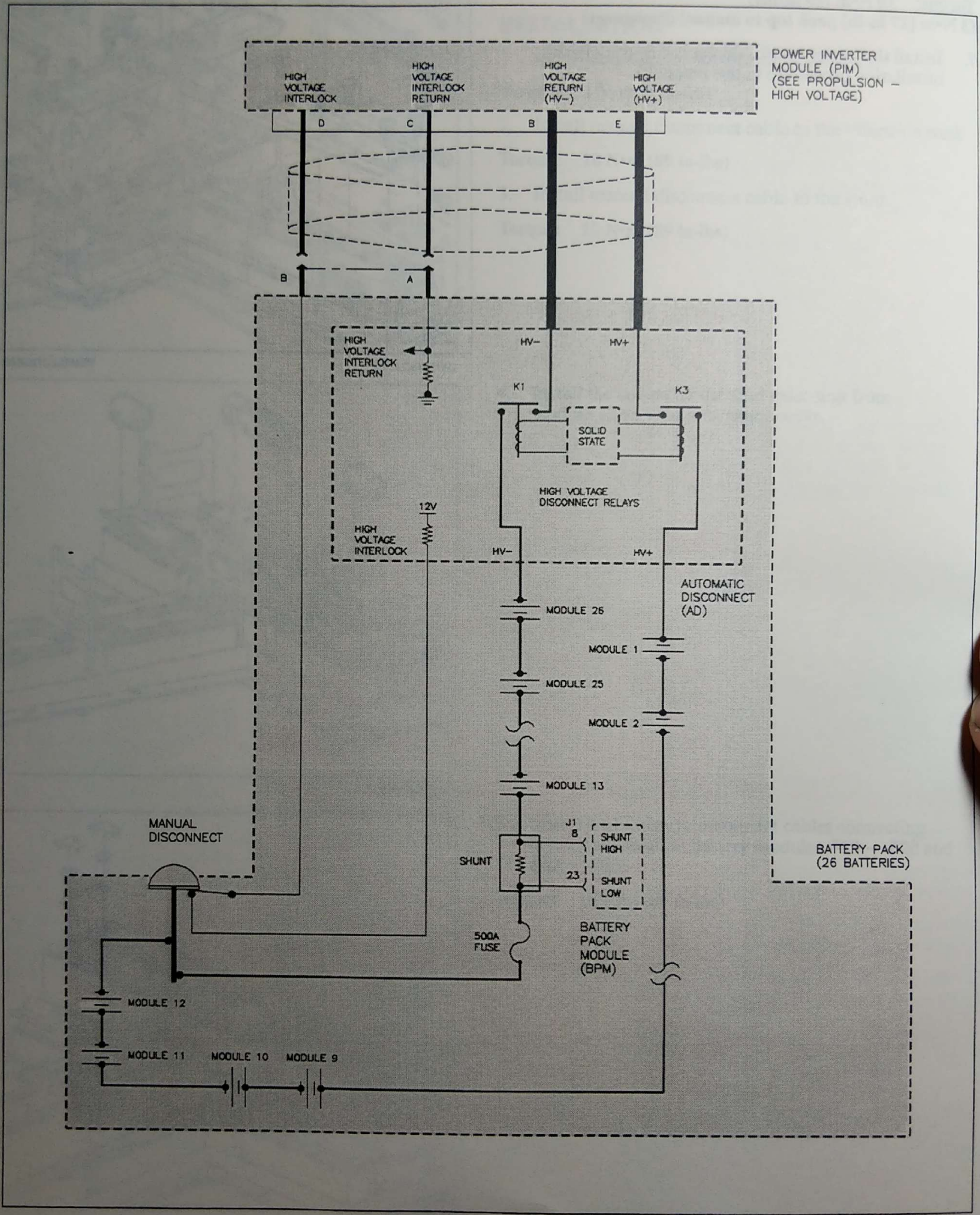
Torque: **10 N•m (89 in-lbs)**
(3 N•m [27 in-lb] pack top to manual disconnect)

7. Install the battery pack. (Refer to "Battery Pack" installation procedure in this manual.)



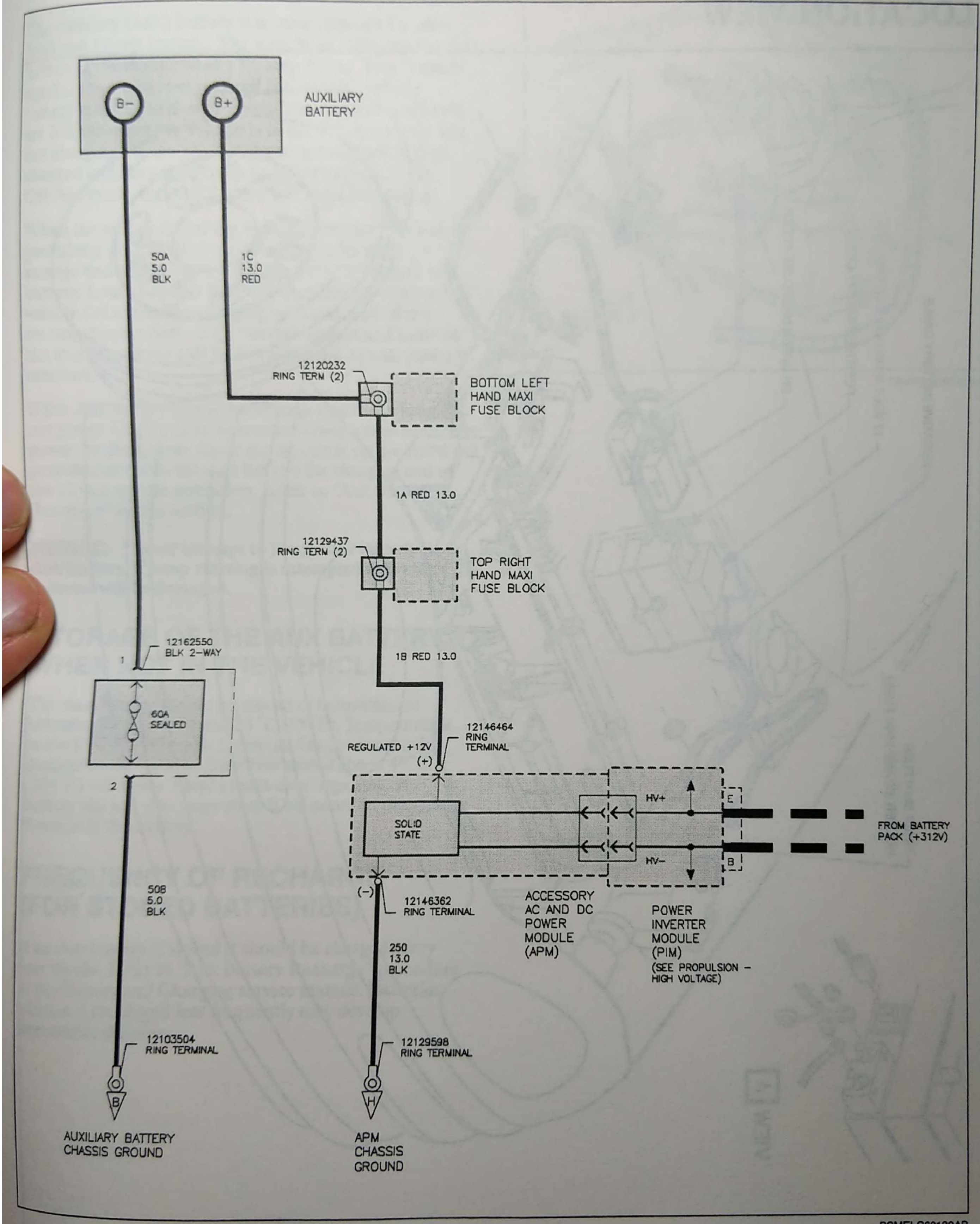
PSMELC67066AB

BATTERY PACK (HIGH VOLTAGE)


HIGH VOLTAGE INTERLOCK
HIGH VOLTAGE INTERLOCK RETURN
HIGH VOLTAGE RETURN (HV−)
HIGH VOLTAGE (HV+)
POWER INVERTER MODULE (PIM) (SEE PROPULSION – HIGH VOLTAGE)
D
C
B
E
B
A
HIGH VOLTAGE INTERLOCK RETURN
HV−
HV+
K1
K3
SOLID STATE
HIGH VOLTAGE DISCONNECT RELAYS
12V
HIGH VOLTAGE INTERLOCK
HV−
HV+
AUTOMATIC DISCONNECT (AD)
MODULE 26
MODULE 1
MODULE 25
MODULE 2
MODULE 13
J1
8
23
SHUNT HIGH
SHUNT LOW
SHUNT
MANUAL DISCONNECT
BATTERY PACK (26 BATTERIES)
500A FUSE
BATTERY PACK MODULE (BPM)
MODULE 12
MODULE 11
MODULE 10
MODULE 9

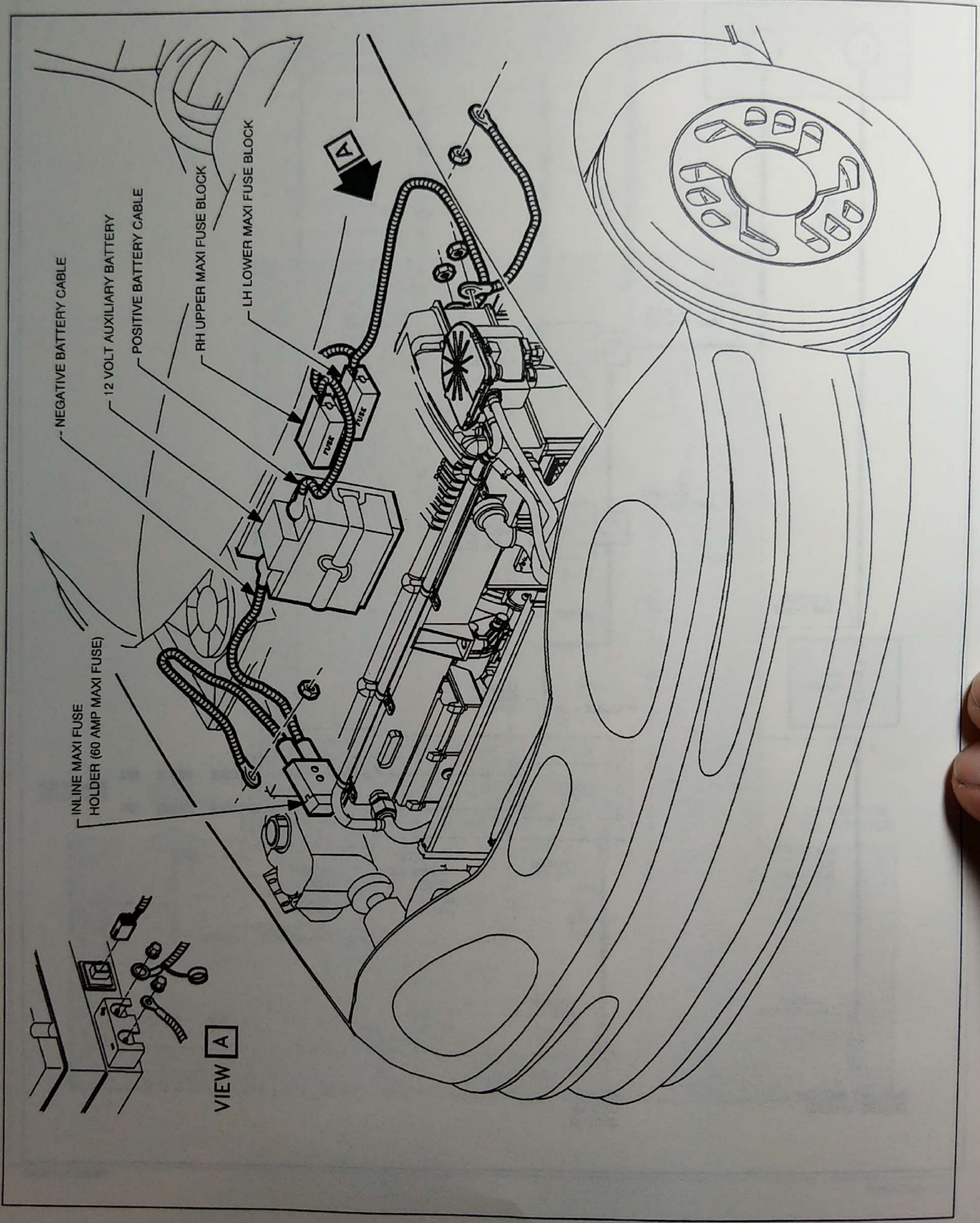
PSMELC68116AA

ACCESSORY AC AND DC POWER MODULE


B−
B+
AUXILIARY BATTERY
50A 5.0 BLK
1C 13.0 RED
12120232 RING TERM (2)
BOTTOM LEFT HAND MAXI FUSE BLOCK
1A RED 13.0
12129437 RING TERM (2)
TOP RIGHT HAND MAXI FUSE BLOCK
12162550 BLK 2–WAY
1
60A SEALED
2
1B RED 13.0
12146464 RING TERMINAL
REGULATED +12V
(+)
SOLID STATE
HV+
HV−
E
B
FROM BATTERY PACK (+312V)
(−)
12146362 RING TERMINAL
ACCESSORY AC AND DC POWER MODULE (APM)
POWER INVERTER MODULE (PIM) (SEE PROPULSION – HIGH VOLTAGE)
50B 5.0 BLK
250 13.0 BLK
12103504 RING TERMINAL
12129598 RING TERMINAL
B
H
AUXILIARY BATTERY CHASSIS GROUND
APM CHASSIS GROUND

PSMELC68130AB

AUXILIARY BATTERY (LOW VOLTAGE) COMPONENT LOCATION VIEW


NEGATIVE BATTERY CABLE
12 VOLT AUXILIARY BATTERY
POSITIVE BATTERY CABLE
RH UPPER MAXI FUSE BLOCK
LH LOWER MAXI FUSE BLOCK
A
FUSE
FUSE
INLINE MAXI FUSE HOLDER (60 AMP MAXI FUSE)
VIEW A

PSMELC68309AA

AUXILIARY

The auxiliary (Aux) battery is a valve regulated sealed lead acid 12 volt battery. The amp hour rating on the Aux battery is relatively low at 17.5 amp-hours. This is much smaller than a normal internal combustion vehicle battery and will discharge much faster if electrical loads are left On when the vehicle is in the Off/Acc mode and not charging. As long as the main battery pack is kept charged and the vehicle is not run excessively in the Off/Acc mode, the Aux battery will remain charged.

When the vehicle is Off the voltage from the Aux battery provides power to all of the controllers for memory storage and any 12 volt system feed directly from the battery. Loss of 12 volt from the Aux battery during the vehicle Off mode (no charging) will cause all of the on-board controllers to go through a reset and some of the stored memory will be lost when the 12 volt power is restored.

If the Aux battery is at a low voltage and the vehicle will not power On, the battery recovery switch may be used to power up the system. Once the system is up the APM will provide current to the Aux battery for charging and to the 12 volt system operation. Refer to "Aux Battery Recovery" in this section.

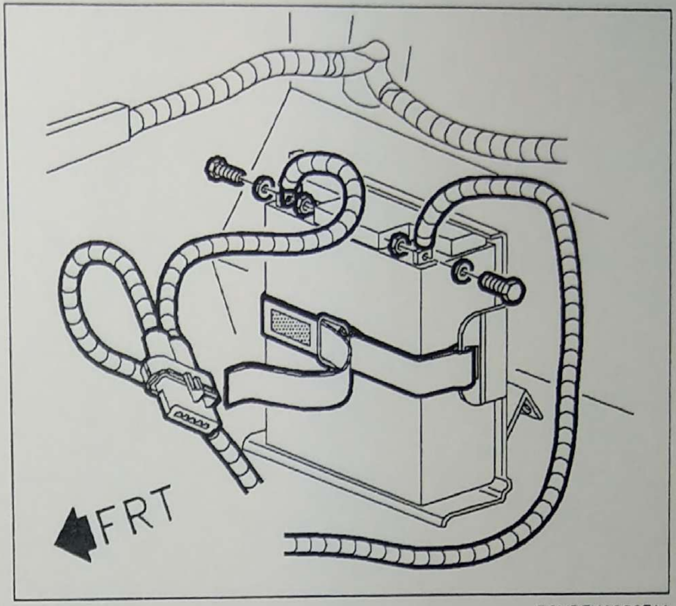
NOTICE: Never attempt to jump start the vehicle or Aux battery. If jump starting is attempted the vehicle systems will be damaged.

STORAGE OF THE AUX BATTERY WHEN NOT IN THE VEHICLE

The Aux battery should be stored at temperatures between 10°C (50°F) and 35°C (95°F). Temperatures below 0°C (32°F) could freeze and cause irreversible damage to the battery. Batteries stored above 40°C (104°F) will cause a higher self-discharge rate. If a battery sits in a discharge state it wll result in irreversible damage to the battery.

FREQUENCY OF RECHARGE (FOR STORED BATTERIES)

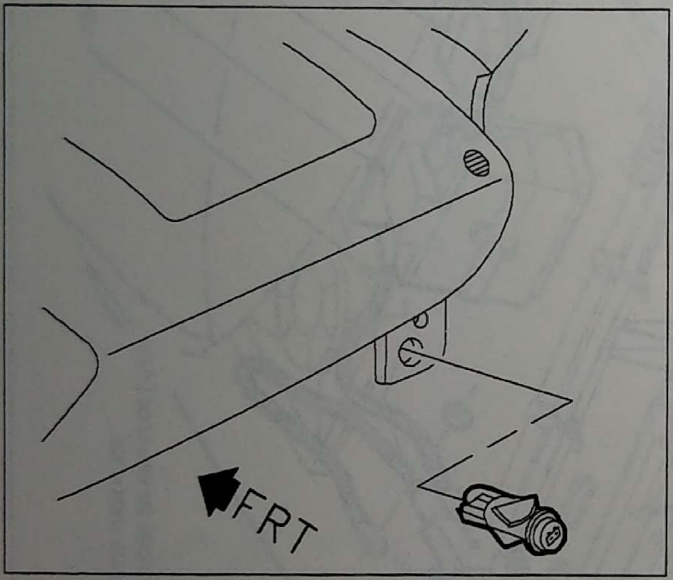
If an Aux battery is stored it should be charged every four weeks. Refer to "Aux Battery Recharge" procedure in the Battery and Charging service manual. Batteries which are recharged less frequently may develop irreversible damage.



PSMPEN66663AA

AUXILIARY BATTERY RECOVER IN VEHICLE

If the vehicle will not power up the battery recovery switch (button) can be used to power up the vehicle if the cause is a discharged Aux battery. The battery recovery switch is supplying 12 volts from the auto disconnect power supply. The auto disconnect power supply is located in the battery pack. The auto disconnect takes the pack voltage as an input to create a 12 volt power supply for the auto disconnect operation. As long as the battery pack voltage is above 180 volts and the BPM has not commanded the HV relays open the auto disconnect system will function and provide 12 volts to the battery recovery switch. When the switch is depressed the 12 volt signal is connected to the vehicle wake-up line allowing the APM to turn On and provide charge power to the Aux battery and 12 volts to the 12 volt systems. To use the battery recovery switch (button) follow the procedure below:



PSMELC65992AA

BATTERY RECOVER PROCEDURE

1. Locate the battery recover button located on the passenger side of the vehicle under the instrument panel dose to the far right. The button has a picture of a battery.
2. Momentarily press and release the battery recovery button.
3. Wait 30 seconds.
4. Press and hold the battery recovery button for three seconds, then release the button.
5. Enter your Run/Lock shifter assembly (RSA) key code and press Run restoring the system.

AUX BATTERY LOW VOLTAGE OR RECHARGE REQUIRED

1. Remove the Aux battery from the vehicle. (Refer to Auxiliary Battery" removal procedure in this service manual.)
2. Measure the voltage of the Aux battery. (Aux battery should be out of the vehicle.)
3. If the voltage is less than 12 volts replace the battery. If not, continue.
4. Before charging begins, make sure battery temperature is between 10°C (50°F) and 35°C (95°F).
5. Connect the Aux battery to a constant voltage charger (positive lead to positive terminal and negative lead to negative terminal).
6. Set the voltage level to 14.7 volts. The maximum current should be 5.0 amps.
7. Charger the Aux battery for four hours or until the current reaches 0.5 amps, whichever occurs first.

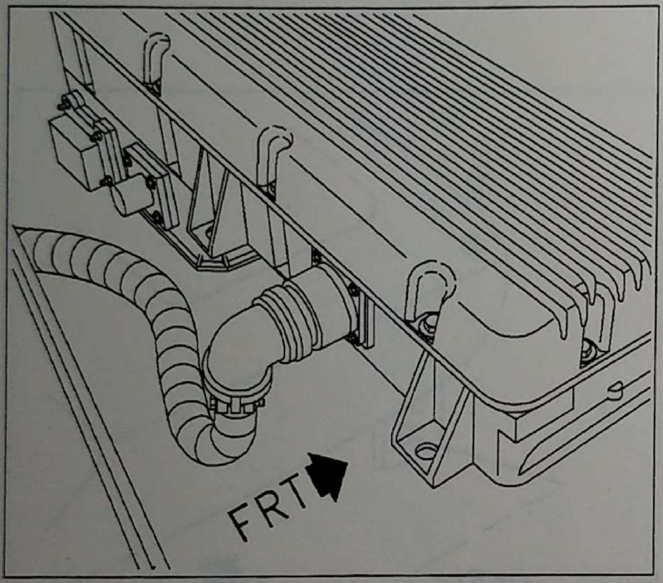
NOTICE: The Aux battery is very easy to overcharge. Make sure the above criteria is not exceeded or it will cause swelling and gassing of the battery. If this condition occurs the battery is not usable.

AUXILIARY BATTERY

REMOVAL

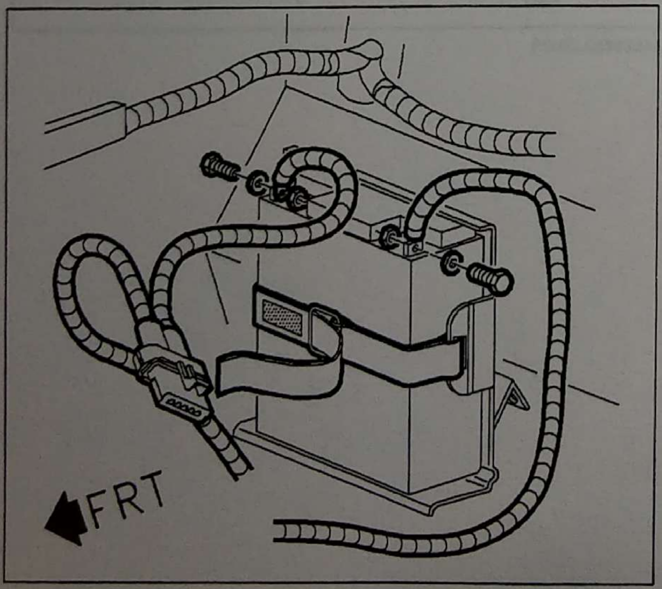
CAUTION: TO REDUCE THE RISK OF SEVERE SHOCKS AND BURNS, THE HIGH VOLTAGE SYSTEM SHOULD BE DISABLED ANY TIME SERVICE WORK IS BEING PERFORMED ON OR AROUND THE HIGH VOLTAGE SYSTEM. WHEN IN DOUBT, ALWAYS DISABLE THE HIGH VOLTAGE SYSTEM. THE 12 VOLT SYSTEM WILL STILL BE ACTIVE AFTER THE HIGH VOLTAGE SYSTEM HAS BEEN DISABLED.

1. Disable high voltage. (Refer to "High Voltage Disable" procedure at the front of this manual.)
2. Disable 12 volt system. (Refer to "12 Volt System Disable" procedure at the front of manual.)
3. Remove the battery pack cannon connector and position out of the way.



PSMPEN66279AA

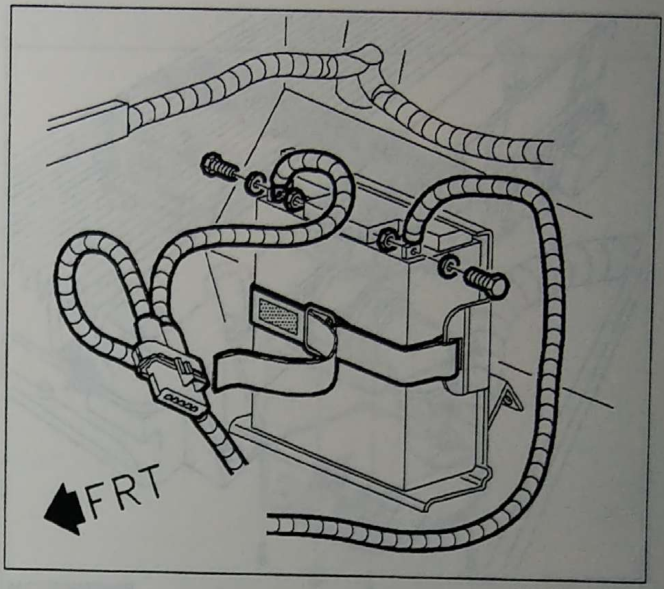
4. Lift the boot to expose positive terminal on the driver's side of battery.
5. Using a T25 TORX® and a 8 mm wrench or socket remove the cable from the terminals
6. Disconnect the velcro strap by pulling up and through the metal retainer.



PSMPEN66663AA

CS CamScanner

7. Pull the aux battery forward and up to disconnect the battery from the velcro at the bottom of the battery.
8. Turn the battery counter clockwise to access the passenger side, negative terminal.
9. Lift the boot on the left terminal and remove.
10. Carefully lift the battery between the PIM and the front of dash.

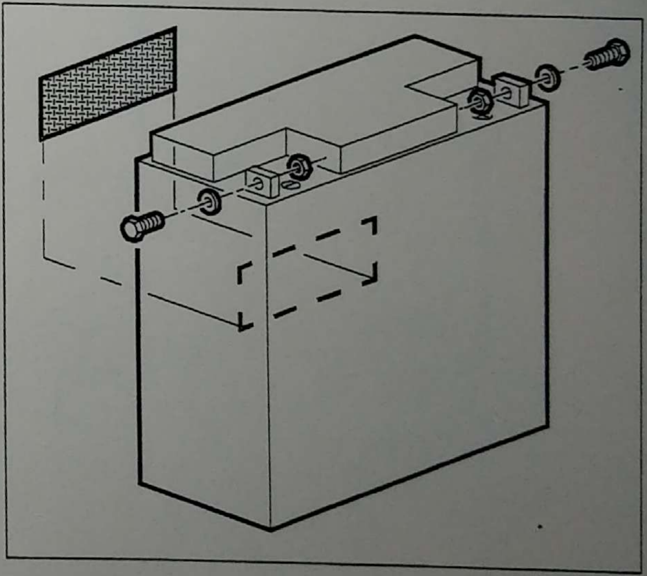


PSMPEN66663AA

INSTALLATION

1. If installing a new battery make sure you install the velcro strip on the back of the battery.
2. Carefully slide the battery between the PIM and the front of dash.
3. Rotate the battery and install the negative cable to the battery and push the boot don over the terminal.

Torque: 6 N•m (53 in–lbs)

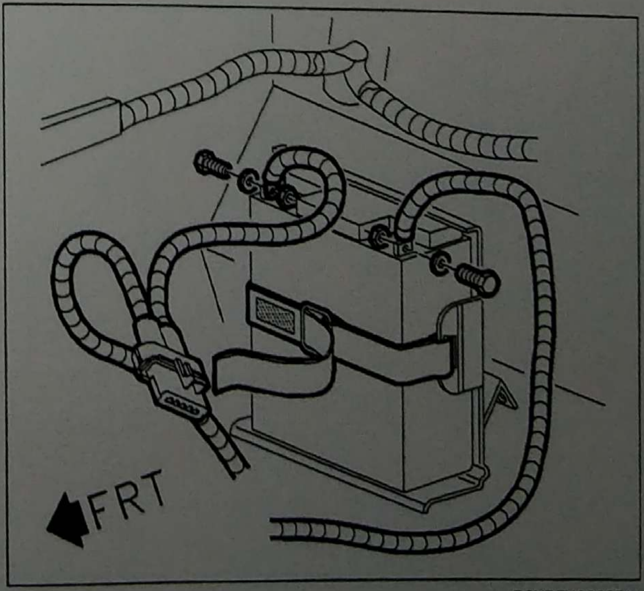


PSMPEN66665AA

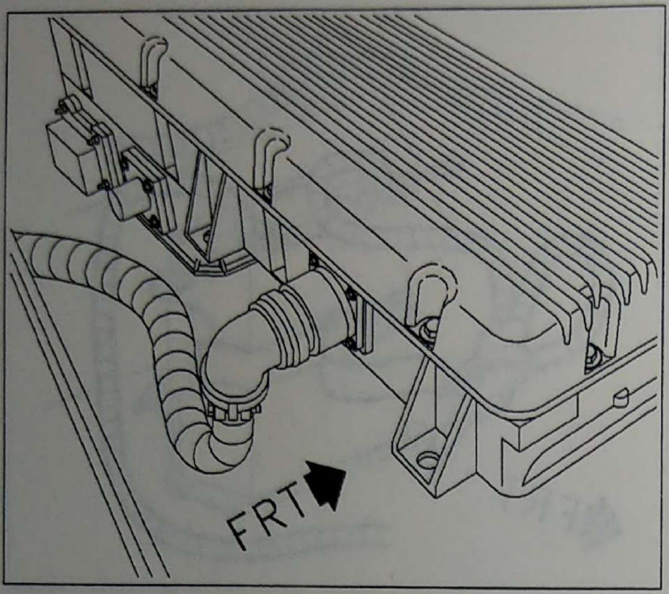
4. Place the battery in the bracket and fasten the velcro strap.
5. Install the positive cable to the battery and push the boot down over the terminal.

Torque: 6 N•m (53 in–lbs)

6. Install the battery pack cannon connector.



PSMPEN66663AA



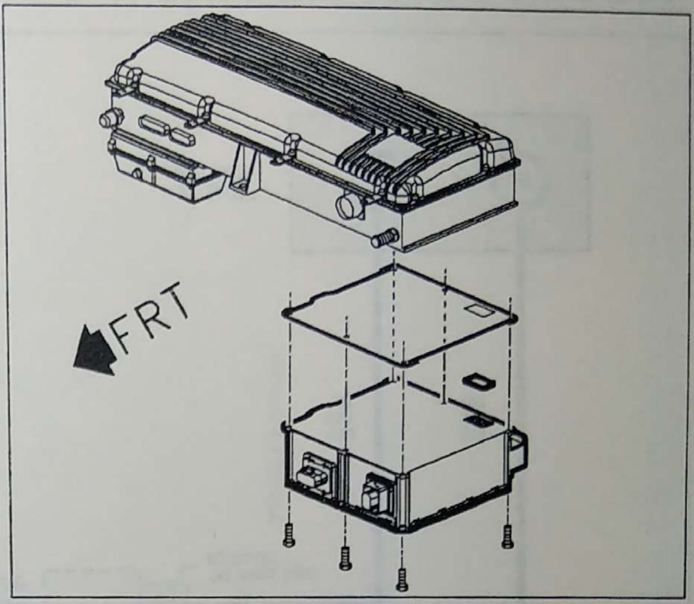
PSMPEN66279AA

7. Enable 12 volt system. (Refer to "Enable" procedure in the front of this manual.)
8. Enable high voltage. (Refer to "High Voltage Disable" procedure at the front of this manual.)

ACCESSORY AC AND DC POWER MODULE (APM)

REMOVAL

1. Remove the power electronics bay (PEB). (Refer to the "PEB" removal procedure in this service manual.)
2. With the PEB removed turn the PEB over onto a soft surface to prevent scratching or damaging the PEB cover.
3. Remove the six accessory AC and DC power module (APM) to power inverter module (PIM) screws.
4. Carefully lift the APM straight up from the PIM until the connector is disconnected. Remove the APM.
5. Remove the APM gasket and clean the gasket surface with alcohol. The gasket must be replaced.
6. Remove the O-ring seal from the APM to PIM connector cavity.



PSMHVC67059AA

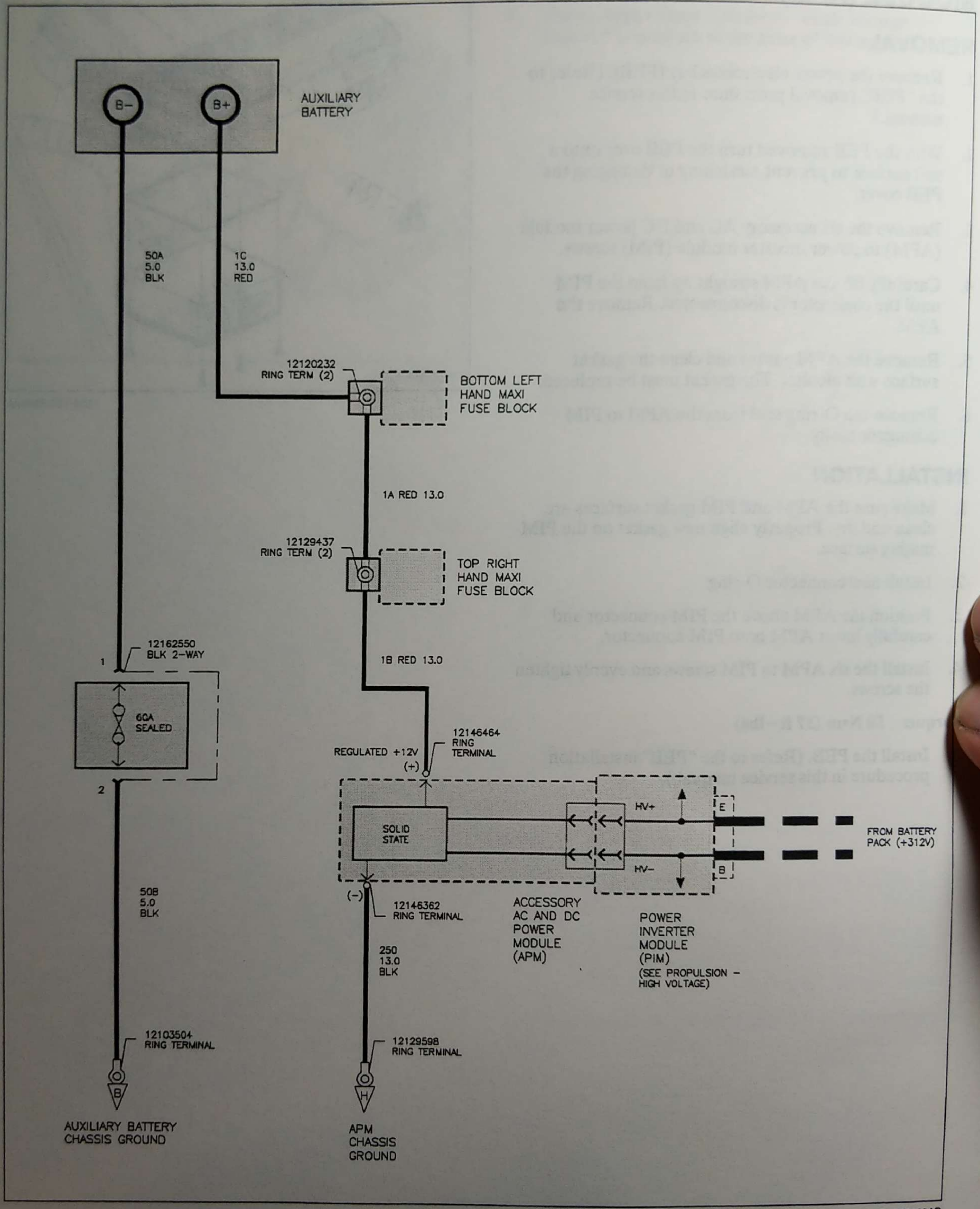
INSTALLATION

1. Make sure the APM and PIM gasket surfaces are clean and dry. Properly align new gasket on the PIM mating surface.
2. Install new connector O-ring
3. Position the APM above the PIM connector and carefully lower APM onto PIM connector.
4. Install the six APM to PIM screws and evenly tighten the screws.

Torque: **50 N•m (37 ft–lbs)**

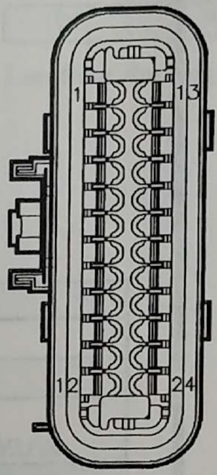
5. Install the PEB. (Refer to the "PEB" installation procedure in this service manual.)

ACCESSORY AC AND DC POWER MODULE


B−
B+
AUXILIARY BATTERY
50A 5.0 BLK
1C 13.0 RED
12120232 RING TERM (2)
BOTTOM LEFT HAND MAXI FUSE BLOCK
1A RED 13.0
12129437 RING TERM (2)
TOP RIGHT HAND MAXI FUSE BLOCK
12162550 BLK 2–WAY
1
60A SEALED
2
1B RED 13.0
12146464 RING TERMINAL
REGULATED +12V
(+)
SOLID STATE
HV+
HV−
E
B
FROM BATTERY PACK (+312V)
(−)
12146362 RING TERMINAL
ACCESSORY AC AND DC POWER MODULE (APM)
POWER INVERTER MODULE (PIM) (SEE PROPULSION – HIGH VOLTAGE)
50B 5.0 BLK
250 13.0 BLK
12103504 RING TERMINAL
12129598 RING TERMINAL
B
H
AUXILIARY BATTERY CHASSIS GROUND
APM CHASSIS GROUND

PSMELC68130AB

ACCESSORY AC AND DC POWER MODULE (APM)



NATURAL
12129225

Location: Underhood, Left Side of Accessory Power Module

PSMELC67235AA

CS CamScanner

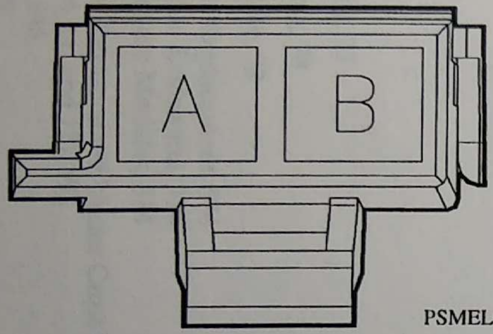
HARNESS CONNECTOR FACES

ACCESSORY AC AND DC POWER MODULE – 12129225

CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
1	BRN	241B	.35	RUN 2
2	WHT	249	.35	AUX POWER SUPPLY (APS) COMMAND IN
3				
4	BLK/WHT	1085	.35	CMC SPEED COMMAND IN
5	RED	1262	.35	APM 12V STATUS BIT 0
6	PPL	1645	.35	BRAKE LOAD SHED
7	ORN	1263	.35	APM 12V STATUS BIT 1
8	PNK/BLK	1217	.35	CMC DC CURRENT
9	DR GRN	1264	.35	APM 12V STATUS BIT 2
10				
11				
12				
13	YEL	820C	.35	BRAKE SWITCH IN
14				
15	WHT	637	.35	HEATED W/S COMMAND IN
16				
17				
18	DK BLU	1081	.35	CMC/47V STATUS BIT 0
19	YEL	1082	.35	CMC/47V STATUS BIT 1
20	PPL	1083	.35	CMC/47V STATUS BIT 2
21				
22				
23				
24	WHT	2027C	.35	VEHICLE WAKE–UP

HARNESS CONNECTOR FACES

BATTERY RECOVERY SWITCH (BRS)



PSMELC67223AA

GRAY
12034341

BATTERY RECOVERY SWITCH – 12034341				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	WHT	26C	.35	AD POWER SUPPLY
B	WHT	2027E	.35	VEHICLE WAKE–UP

Location: Passenger Compartment, Under Right Side of I/P

NOTES

CS CamScanner

Spaces

A

Accessory AC and DC Power Module, 849, 858, 860

Accessory AC and DC Power Module (APM), 857
  Installation, 857
  Removal, 857

Accessory Power Module (APM), 736

Air Flow Sensor, 672
  Installation, 672
  Removal, 672

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CS CamScanner

Service Manual Contents

- High Voltage System Description and Service Procedures
- Range and State Of Charge (SOC) Description
- Battery Module Description, DTCs and Service Procedures
- Battery Pack Systems Description, DTCs and Service Procedures
- Battery Pack Temperature and Airflow Description, DTCs and Service Procedures
- Auto and Manual Disconnect Systems Description, DTCs and Service Procedures
- Serial Data DTCs and Service Procedures
- Charging System Description, DTCs and Service Procedures
- Auxiliary Battery Description, DTCs and Service Procedures

NOTE: Refer to the Index in the back of this manual or the Table of Contents in the front of this manual for location of specific component.

CS CamScanner